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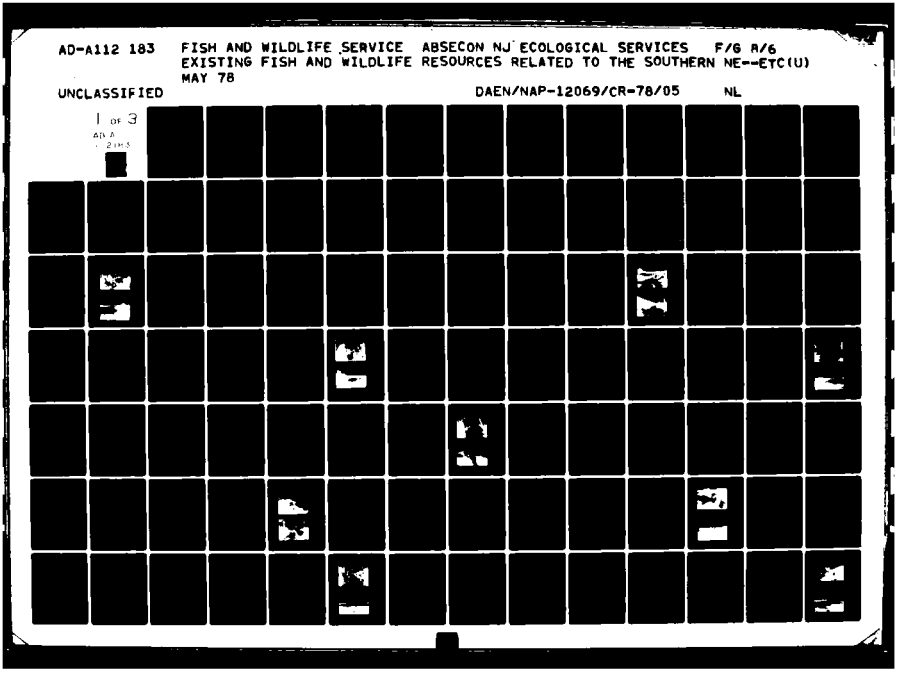

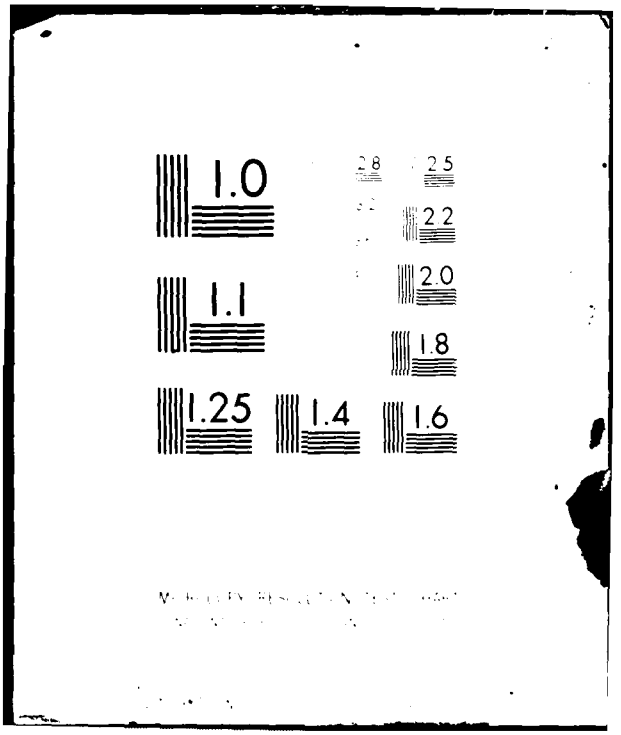
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SOUTHERN NEW JERSEY WATER RESOURCES STUDY

FISH AND WILDLIFE RESOURCES TRI-COUNTY AREA

prepared by
FISH AND WILDLIFE SERVICE
U.S. DEPARTMENT OF INTERIOR

REPORT NO: DAEN/NAP-12069/CR-78/05

MAY 1978

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Southern NJ Water Resources Study

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

--This constitutes a planning aid report of the Fish and Wildlife Service on fish and wildlife resources related to the Southern New Jersey Water Resources Study. The study area is known as the Camden Metropolitan Area including Burlington, Camden and Gloucester Counties, New Jersey. This phase 1 report contained a general investigation of existing fish and wildlife resources. The material presented provided descriptions of aquatic and terrestrial habitats, fish and wildlife species and public uses. A literature review

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was given for biota, land use and water quality of the study area. Several local creeks, rivers and swamps were described.

Errata

p 169, para 1. Line 7 should read "Currently, these violations stem from point and non-point sources discharging into the water system. As point source discharge is regulated and water quality improves, non-point sources will remain a primary pollution factor."

p 174, last para. Last line should read "Actual spawning runs of American shad have not been confirmed in the tri-county study area."

PLANNING AID REPORT

EXISTING FISH AND WILDLIFE RESOURCES RELATED TO THE SOUTHERN NEW JERSEY WATER RESOURCES STUDY BURLINGTON, CAMDEN AND GLOUCESTER COUNTIES, NEW JERSEY

Phase I Report
(May, 1978)

Prepared by

U. S. Department of the Interior
Fish and Wildlife Service
Ecological Services
Absecon, New Jersey

Prepared for

U. S. Army, Corps of Engineers,
Philadelphia District,
Philadelphia, Pennsylvania

REPORT NO: DAEN/NAP - 12069/CR - 78/05

TABLE OF CONTENTS

	Page
INTRODUCTION	1
LITERATURE REVIEW	3
Biota	3
Land Use	5
Water Quality	7
DESCRIPTION OF STUDY AREA	9
Location	9
Geomorphic and Physiographic Provinces	9
Topography and Drainage	11
Soil Types	11
Climate	12
Land Use	12
Urban Growth and Land Use	12
Habitat Types	13
DISCUSSION	15
Crosswicks Creek	15
Blacks Creek	24
Crafts Creek	32
Assiscunk Creek	39
Rancocas Creek	47
Pompeston Creek/Swede Run	58
Pennsauken Creek	65
Cooper River	73
Newton Creek	81
Big Timber Creek	87
Woodbury Creek	95
Mantua Creek	102
Repaupo Creek	109

Table of Contents

	Page
DISCUSSION	
Raccoon Creek	116
Maple Swamp	123
Oldmans Creek	128
Maurice River	136
Great Egg Harbor River	143
Mullica River	151
Public Use	161
SUMMARY	168
A SELECTED BIBLIOGRAPHY	179
APPENDICES	192
Appendix A - Vegetation	193
Appendix B - Fishes	203
Appendix C - Wildlife	241
Appendix D - Environmental Questionnaires	260

LIST OF TABLES

Table		Page
1	County Public Use Estimates	162

LIST OF FIGURES

Figure		Page
1.	The Study Area	10
2.	Crosswicks Creek	14
3.	Blacks Creek	23
4.	Crafts Creek	31
5.	Assiscunk Creek	38
6.	Rancocas Creek	46
7.	Pompeston Creek/Swede Run	57
8.	Pennsauken Creek	64
9.	Cooper River	72
10.	Newton Creek	80
11.	Big Timber Creek	86
12.	Woodbury Creek	94
13.	Mantua Creek	101
14.	Repaupo Creek	108
15.	Raccoon Creek	115
16.	Maple Swamp	122
17.	Oldmans Creek	127
18.	Maurice River	135
19.	Great Egg Harbor River	142
20.	Mullica River	150

Abbreviations List:

cfs - cubic feet per second.

Class FW-1 - Fresh waters, including rivers, streams, lakes or other bodies of water, that because of their clarity, color, scenic setting, or other characteristic of aesthetic value or unique special interest, have been designated by authorized State agencies in conformance with laws pertaining to the use of private lands, are set aside for posterity to represent the natural aquatic environment and its associated biota.

Class FW-2 - Fresh surface waters approved as sources of public water supply. These waters shall be suitable for public potable water supply after such treatment as shall be required by the Department.

These waters shall also be suitable for the maintenance, migration and propagation of the natural and established biota, and for primary contact recreation; industrial and agricultural water supply and any other reasonable uses.

Class FW-3 - Fresh surface waters suitable for the maintenance, migration and propagation of the natural and established biota: and for primary contact recreation; industrial and agricultural water supply and any other reasonable uses.

Class FW-Central Pine Barrens - These waters shall be suitable for agricultural water supply: public potable water supply

Abbreviations List - continued

after such treatment as shall be required by law or regulation; continual replenishment of surface waters to maintain the existing quantity and high quality of the surface waters in the Central Pine Barrens; and other reasonable uses.

Class TW-1 - Tidal waters approved as sources of public potable water supply after such treatment as shall be required by the Department.

These waters shall be suitable for shellfish harvesting where permitted.

These waters shall also be suitable for the maintenance, migration and propagation of the natural and established biota; and for primary contact recreation; industrial and agricultural water supply and any other reasonable uses.

Class TW-2 - Tidal waters suitable for secondary contact recreation but not primary contact recreation; the maintenance of fish populations; the migration of anadromous fish; the maintenance of wildlife and any other reasonable uses.

DO - dissolved oxygen

DVRPC - Delaware Valley Regional Planning Commission

EPA - U.S. Environmental Protection Agency

EPA STORET - EPA Storage and Retrieval Water Quality Data Bank

msl - mean sea level

Abbreviations List - continued

NH_3^-N - ammonia nitrogen

pH - hydrogen ion concentration

TP - total phosphorous

U.S.G.S. - U.S. Geological Survey

INTRODUCTION

This constitutes a Planning Aid Report of the Fish and Wildlife Service on fish and wildlife resources related to the Southern New Jersey Water Resources Study. The study region is known as the Camden Metropolitan area, including Burlington, Camden and Gloucester Counties, New Jersey. This report represents the completion of Phase I of an overall three phase evaluation of the study area. Phase II will contain a further evaluation of the Rancocas, Cooper and Mantua drainage basins. The final phase will provide conclusions to the study.

This study was authorized by resolutions of the Senate and House of Representatives Committees on Public Works, adopted March 20, 1973 and April 11, 1974, respectively. The resolutions authorize the Corps of Engineers to investigate the need to provide plans for the development, use and conservation of water and related land resources of the Camden Metropolitan area. This report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C., et seq.).

Phase I contains a general investigation of existing fish and wildlife resources. Overall, this phase of the study provides descriptions of aquatic and terrestrial habitats, fish and wildlife species composition, threatened or endangered species, important and unique habitat and public uses.

INTRODUCTION

The information comprising Phase I was obtained from numerous sources, including previous studies, field investigations and the cooperation of State fish and game biologists. As an additional data source, environmental questionnaires were mailed to all environmental organizations concerned with this geographic area (Appendix D).

LITERATURE REVIEW

Biota

Fish species reported to occur in the study area are listed by Fowler (1906, 1907b, 1920, 1952), Hastings (1977), Stewart (1976), Zich (1977) and Bolton (1978, pers. comm.). Additional investigations, including McCormick (1970), Scheier and Kiry (1973), Academy of Natural Sciences of Philadelphia (1975), Good, et al. (1975) and the U. S. Fish and Wildlife Service (1975), also list species composition, but to localized sites within the study area. In addition, McClain (1970) identified fish species from the Mullica River, Great Bay Estuary, and the Maurice River. Similarly, Craighead (1971) identified the principal fish species from tributaries to the Delaware Estuary-Bay.

Fowler (1907a) identifies amphibians and reptiles that occurred in New Jersey during the turn of the century. Although pertaining to localized sites, more recent species lists appear in McCormick (1970), J. McCormick & Associates (1973), Conservation and Environmental Study Center (1974a,b), A. Gershen Associates (1975), Environmental Assessment Council (1977), Price (1977) and Thomas (1977).

Early occurrences of mammalian species are given by Stone (1908). A more recent study by McManus (1974) presents a detailed list of mammals. Although pertaining to localized sites, additional lists of mammalian species are given by McCormick (1970),

LITERATURE REVIEW

J. McCormick & Associates (1973), Conservation and Environmental Study Center (1974a,b), Good, et al. (1975), A. Gershen Associates (1975) and the Environmental Assessment Council (1977).

Descriptive characteristics of avifauna are reported in the Annual Report of the New Jersey State Museum (1904). Localized listings of avian species are reported by A. Gershen Associates (1975), Price (1975) and the Environmental Assessment Council (1977).

Investigations pertaining to the Pine Barrens avifauna portion of the study area include McCormick (1970), J. McCormick & Associates (1973), Conservation and Environmental Study Center (1974a,b), and Thomas (1977). The Academy of Natural Sciences of Philadelphia (1975) and Good, et al. (1975) list avifauna associated with two marshes in the study area.

Studies reveal two major forest types, mixed oak and pine, contained within the study area. Various subtypes, containing different species compositions and transitions between the mixed oak and pine forest types also prevail. The vegetation associated with the Inner Coastal Plain portion of the study area is discussed by Robichaud and Buell (1973), J. McCormick & Associates (1974,1975, 1976), A. Gershen Associates (1975), Rogers & Golden (1976) and the Environmental Assessment Council (1977).

LITERATURE REVIEW

A large portion of the study area includes the Pine Barrens. Vegetational studies of the Barrens include Stone (1910), Harshberger (1916), McCormick (1970), Robichaud and Buell (1973), Conservation and Environmental Study Center (1974a,b) and Thomas (1977).

Vegetational community structures of two marshes in the study area are discussed by the Academy of Natural Sciences of Philadelphia (1975) and Good, et al. (1975). Similarly, Craighead (1971) identified aquatic vascular plants found in tributaries to the Delaware Bay-Estuary.

Rare and endangered plants of New Jersey are listed by Fairbrothers and Hough (1973). Endangered, threatened peripheral and undetermined wildlife species are officially listed by the State of New Jersey Department of Environmental Protection in the State Register (N.J. DEP, 1975a).

Land Use

Several factors are considered when making land use decisions and policies. These factors are presented by various investigations. Stankowski (1972) and the Delaware Valley Regional Planning Commission (DVRPC, 1976a,b,c) show how highway accessibility and existing development have a major land use impact. In addition, the United States Soil Conservation Service (1962, 1966, 1971) points out that soil characteristics, including

LITERATURE REVIEW

permeability and compaction are necessary for determining land use. Furthermore, the Corps of Engineers (1967), Stankowski (1974) and J. McCormick & Associates (1974,1975,1976) state the importance concerning floodplains, flooding and floodplain development. Moreover, J. McCormick & Associates (1974,1975, 1976) and DVRPC (1975b) discuss ecologically sensitive areas, including wetlands, steep slopes, aquifer recharge areas, wildlife refuges and other important open space that may be affected by land use objectives.

Several investigators, including the Corps of Engineers (1967), Durand and Nadeau (1972), Porter and Ripa (1974), J. McCormick & Associates (1974,1975,1976), DVRPC (1976b), N.J. DEP (1976a), Rogers and Golden (1976) and the Southern Jersey Resource Conservation and Development Council (SJRCDC, 1978) indicate that water quality is directly influenced by land use practices.

Specific data relating to land use show water quality problems to include: 1) saltwater intrusion (Durand and Nadeau, 1972; Porter and Ripa, 1974; J. McCormick & Associates, 1974,1975, 1976; and Kull, 1977a,b); 2) groundwater supply and quality (J. McCormick & Associates, 1974,1975,1976; DVRPC, 1976b; and Rogers and Golden, 1976); 3) surface water quality (Porter and Ripa, 1974; J. McCormick & Associates, 1974,1975,1976; Rogers and Golden, 1976: DVRPC, 1976b; and SJRCDC, 1978); and 4) flooding (Army Corps of Engineers, 1967; Stankowski, 1974;

LITERATURE REVIEW

J. McCormick & Associates, 1974,1975,1976; and DVRPC, 1976b).

To minimize environmental degradation, alternatives for existing and future land use practices are proposed by DVRPC (1976d,e) and the Corps of Engineers (1967). These alternatives include zoning, developing performance standards and building codes. In addition, coastal zone and estuarine environments have been recommended for specific land use objectives by Durand and Nadeau (1972), N.J. DEP (1976a,b) and Kull (1977a). Similarly, other environmental concerns include floodplains (Corps of Engineers, 1967; Stankowski, 1974; J. McCormick & Associates, 1974,1975,1976; DVRPC, 1976b) and acquisition of unprotected land (Conservation and Environmental Studies Center, 1974a,b).

Water Quality

Water quality is one of the most severely stressed elements of the Delaware River estuary. The Delaware Valley Regional Planning Commission (1976b), Kiry (1974), and the N.J. DEP (1975b) have analyzed historical data on water quality in the Delaware River estuary. Summaries of water quality data for the Delaware estuary, bay and tributaries are presented by Brezina, et al. (1976) and Delaware River Basin Commission (DRBC, 1976). Current water quality data are presented by the U.S. Environmental Protection Agency (1977) and U.S. Geological Survey (1977).

The effect of wastewater management on water supply and quality

LITERATURE REVIEW

in the study area is discussed by Porter-Ripa Associates (1974), J. McCormick & Associates (1974, 1975, 1976), the Corps of Engineers (1975) and DVRPC (1977). An evaluation system to assess the effects of the use of water resources on the environment has been developed by Battelle Columbus Laboratories (1972).

Water quality problems in some of the major drainage basins within the study area are discussed by Hydroscience (1975, 1976a,b) and N.J. DEP (1976a). The Academy of Natural Sciences of Philadelphia (1971, 1973a,b) and A. Gershen Associates (1975) discuss water quality problems of localized sites.

The importance of groundwater quality is discussed by J. McCormick & Associates (1974, 1975, 1976), A. Gershen Associates (1975), DVRPC (1975b, 1977), N.J. DEP (1976) and Kull (1977a,b).

Water quality problems in marshes and wetlands were investigated by Good, et al. (1975) and Kull (1977a).

The Delaware Valley Regional Planning Commission (1975a) describes the role of forested areas in maintaining water quality through erosion control and leaching prevention.

Studies by Ellis, et al (1947), Durand and Nadeau (1972), Scheier and Kiry (1973), Zich (1977) and the U.S. Fish and Wildlife Service (1975, 1977a,b) show the importance of water quality to fish populations. Dissolved oxygen has been identified by Ellis, et al (1947) and the U.S. Fish and Wildlife Service (1975) as the major disturbing factor in shad migration. The socio-economic effects of toxicants on fish and shellfish are discussed by Scheier and Kiry (1973).

DESCRIPTION OF STUDY AREA

Location:

The study area (Figure 1) is located in southwestern New Jersey and encompasses the political boundaries of Burlington, Camden, and Gloucester Counties. The approximately 1400 mi^2 area is bordered on the north by Trenton and on the south by Swedesboro-Vineland-Hammonton and Port Republic. The Delaware River is the western limit, while the Mullica River drainage is the easternmost border of the Study. Major urban concentrations occur in Camden and near Trenton, with industrial development predominantly along the Delaware River. The study area contains nineteen major drainage basins.

Geomorphic and Physiographic Provinces:

Burlington, Camden and Gloucester Counties lie within the Atlantic Coastal Plain Provinces. More specifically, these counties are located in the Inner and Outer Coastal Plain, comprising about 60 percent of the total land area of the State. Both the Inner and Outer Coastal plains have their origin in depositions of clays, silts, sands, and gravels. These layers of Quaternary, Tertiary, and Cretaceous eras lie on a bedrock surface of metamorphic and igneous rocks of early Paleozoic age. During the last Ice Age, when New Jersey was covered by the Wisconsin Ice Sheet, sands and gravels were washed down from the ice front by streams emanating from the glacier.

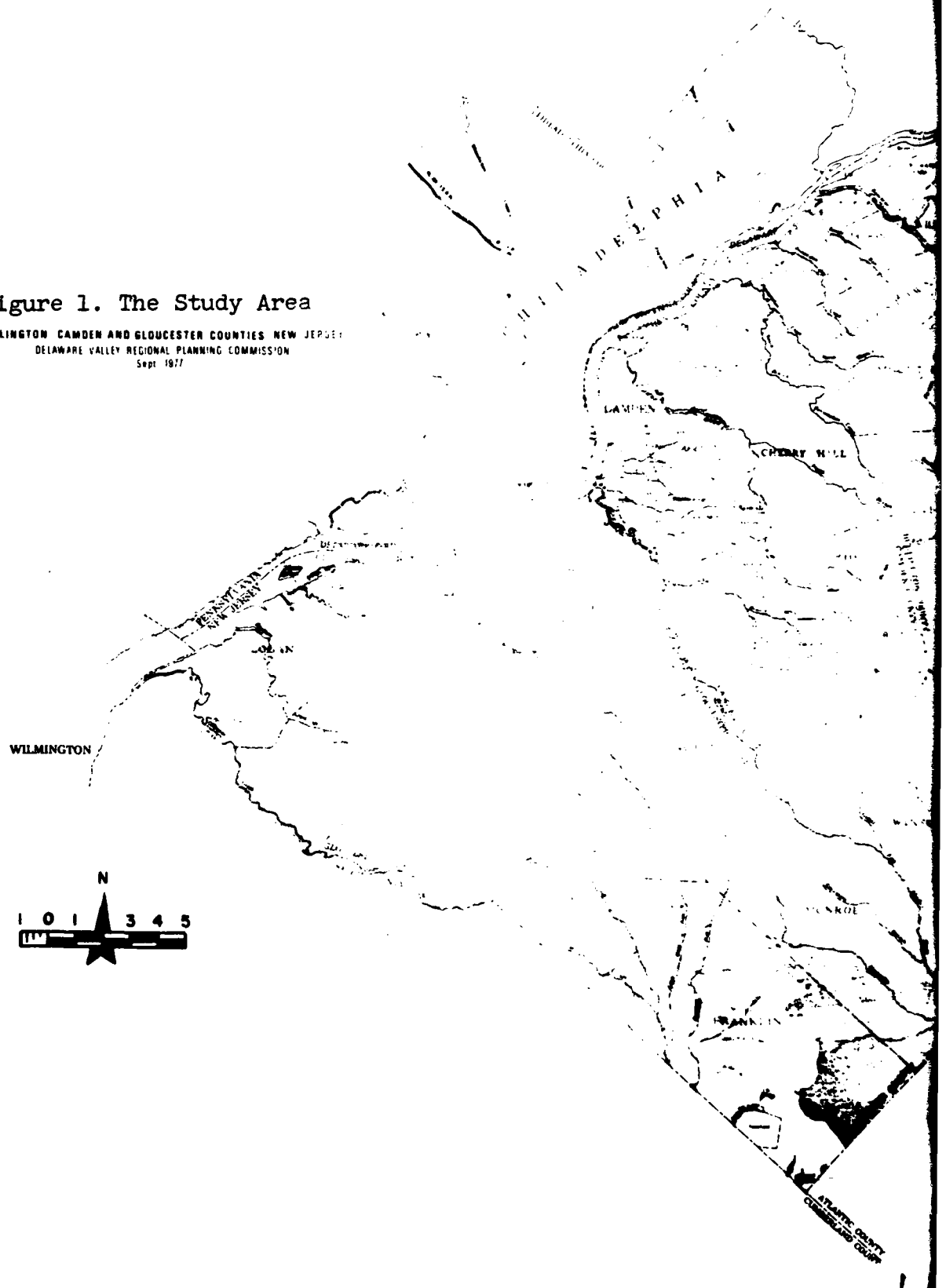
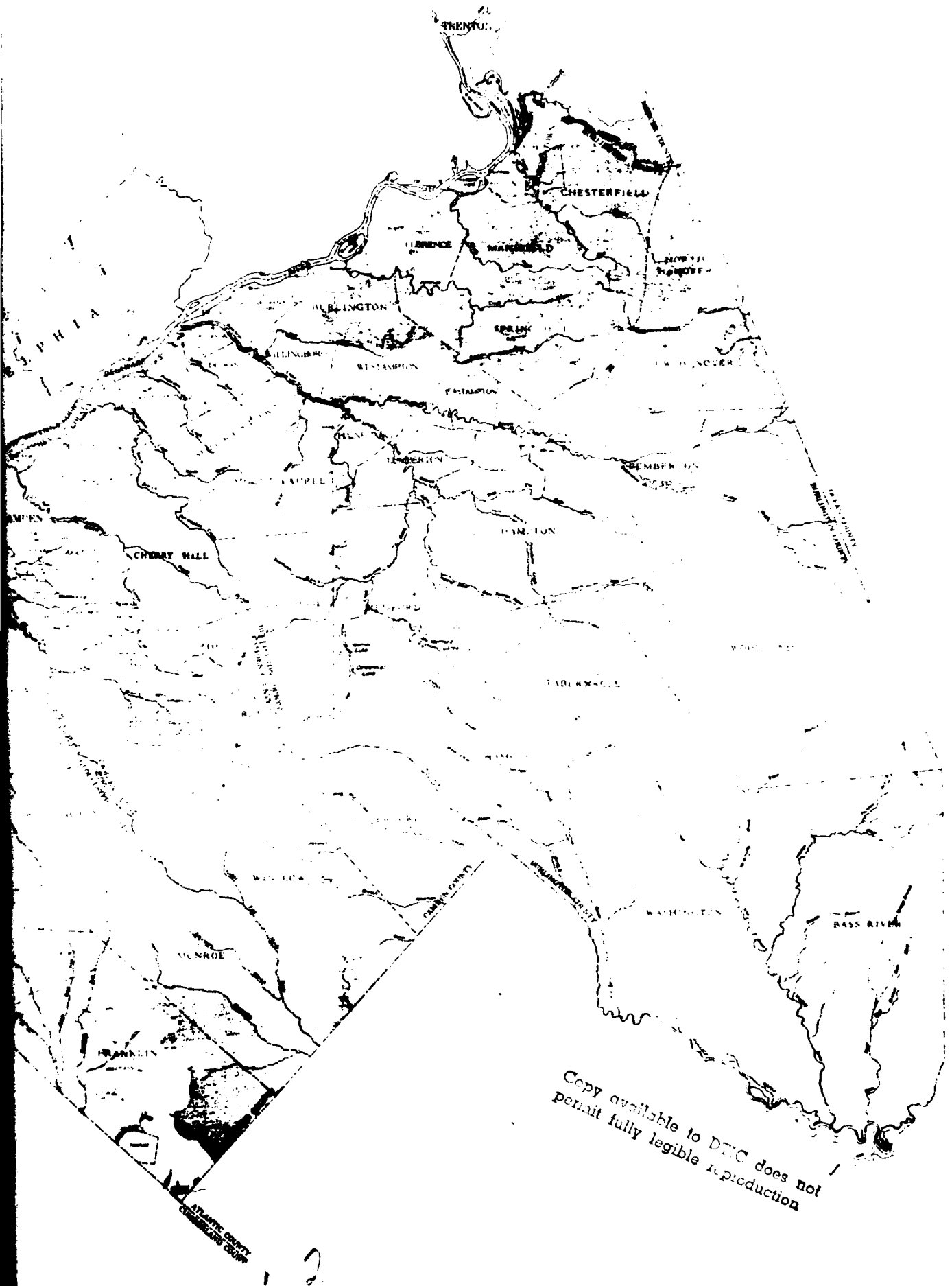


Figure 1. The Study Area

BURLINGTON CAMDEN AND GLOUCESTER COUNTIES NEW JERSEY
DELAWARE VALLEY REGIONAL PLANNING COMMISSION
Sept 1977



Topography and Drainage:

The terrain throughout the study area ranges from flat to gently rolling with minimal relief. A series of low hills, forming the topographic divide between the Delaware River and the Atlantic Ocean drainages, extends in a southwest to northeast direction through the central portion of the study area.

Soil Types:

A variety of sands and clays comprise the surface soils of the study area. Along the Delaware River and inland along streams are larger areas of tidal marsh and other low-lying, wet, and frequently flooded soils (i.e., floodplain). Further inland are moderately to strongly sloping belts of isolated spots of fertile, well drained sandy soil, which support much of the agriculture of the region. Interspersed among these belts in the area between the river and the drainage divide are a number of areas of gently to steeply sloping clay soils that are fertile but not easily cultivated. Along the drainage divide is a bank of fine sandy soils that are somewhat gravelly, well drained, moderately fertile and conducive to agriculture. Beyond the drainage divide are very light textured, gray sands and areas containing well developed subsoils. The gray sands are noted for their ability to absorb precipitation and transmit it to the water-table. Most notable of these sands is the Lakewood Sand. The gray sand areas are mostly in pine woodlands, and the well developed subsoil areas are often farmed.

Climate:

The study area is in a region of temperate climate. Winters are relatively mild with occasional cold spells and summers are humid. Rarely does the temperature rise above 95°F (35°C) or fall below 10°F (-12.3°C). Rainfall is abundant and relatively well distributed throughout the year. The growing season experiences the most accumulation of rain and lasts for approximately 185 days.

Land Use:

Agriculture occupies a substantial amount of acreage within the study area. Most of the present farming is located in Gloucester County. Woodlands and wetlands are the second major use of open space. The Wharton Tract State Forest contains the largest woodland area in the study. Urbanization is greatest between Bordentown and Paulsboro. Industrial development is greatest along the Delaware River. Major highways (e.g., New Jersey Turnpike, Interstate 295) contribute greatly to industrial development.

Urban Growth and Land Use:

Population trends of the three counties of the study indicate an increase of 300,000 to 350,000 persons by the year 2000 (DVRPC, 1975). More specifically, major population increases are expected to occur in ten of the nineteen study basins. Since the water and related land resources are currently under

stress, this condition will accelerate with future growth.

Habitat Types:

There are many different habitat types, both manipulated and undisturbed, located in the study area. These include wetland habitat, terrestrial habitat, agricultural fields, abandoned fields, lakes, streams, natural riparian habitat and the unique Pine Barrens.

Vegetational community structure differs from the westernmost portion, to the easternmost boundary of the study area. A mixed oak forest type prevails along the Delaware River and extends inland until species composition changes to a mixed oak-pine forest. This forest type transcends into the Pine Barrens as pine species become more dominant.

Figure 2a. Headwater tributary northeast of Cookstown.

Figure 2b. Mainstem segment north of Bordentown.

DISCUSSION

Crosswicks Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Although only 25 percent of the Crosswicks Creek basin is located within the study area, we have chosen to present a basinwide evaluation of fish and wildlife resources. Overall, Crosswicks Creek drains an area of approximately 140 mi^2 within Burlington, Mercer, Ocean and Monmouth Counties. In 1970 this area supported a population of approximately 25,000 people.

The main channel is tidal for nine miles, where the Crosswicks Mill Dam creates a barrier. This tidal segment, which drains approximately 50 mi^2 of the basin, contains extensive wetland areas and is referred to as the Crosswicks Creek Marsh. A second dam in the basin located at New Egypt is outside of the study area. Major tributaries in the basin include Thorton Creek, Doctors Creek, Miry Run, North Run, South Run, Bank Edges Brook and Jumping Brook. Only Thorton Creek, North Run, South Run and Jumping Brook flow through the study area.

Although agricultural/forested land comprises almost

80 percent of the basin (DVRPC, 1977), several areas, particularly between Bordentown and Trenton are characterized by heavy urban/suburban development. Considerable development is also evident around McGuire Air Force Base which contains the North and South Run headwater regions.

b. Water Quality: Urban concentrations located at the mouth as well as in the Headwater regions have a direct, adverse influence on water quality. EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe problems with fecal coliform and TP throughout the basin. Severe violations of pH standards (as established by the 208 Regional Water Quality Management Program) and moderate violations of DO and NH_3-N standards have been reported in several segments of the watercourse. These violations stem from six municipal, six non-municipal and one industrial point source discharges. In addition, there are site-specific non-point sources discharging from two active and two inactive landfills. Further, a waste lagoon located in the Thorton Creek sub-basin may be considered a potential site-specific non-point source of pollution. Although major developments are

sewered, septic system-related problems are contributing to violations of TP, fecal coliform and NH_3-N standards. Runoff from agricultural and urban areas creates a further problem by accelerating the organic, nutrient, sediment and sediment related pollutant load on the watercourse. Sedimentation is especially severe in agricultural areas where protective riparian vegetation has been removed.

Although some organic enrichment occurs, a relatively healthy invertebrate fauna has been sampled in the Crosswicks Creek Marsh (Academy of Natural Sciences of Philadelphia, 1975). Organisms included flatworms, aquatic earthworms, leaches, clams, mussels, snails, sideswimmers, slaters, and grass shrimp. Since invertebrate composition and distribution is controlled by environmental conditions, invertebrate occurrence in other portions of the basin would vary considerably. Data (Craighead, 1971) report chironomid larvae as the most common species in Crosswicks Creek.

c. Lotic: The watercourse flows for approximately 31 miles before draining into the Delaware River.

Crosswicks Creek

To illustrate the magnitude and fluctuation of discharge, a U.S.G.S. gauging station located 13 miles above the Delaware River recorded an average annual flow of 126 cfs while recording only 22 cfs during low flow periods. In the tidal segment, mean width is approximately 75 feet and mean depth about four feet. In upstream segments, mean width is approximately 10 feet and mean depth about one foot. Substrate consists mostly of mud, sand and gravel. Sand content increases in upstream reaches. The floodplain adjacent to the main axis of the channel (including developed portions) receives annual inundation. Developments in the floodplain have accelerated storm runoff and have increased peak discharges.

Width of the floodplain varies from 200 to 1500 feet. However, along the tidal segment the floodplain spans a half mile in places. Compared to the main trunk and headwater regions, mid-segments are less intensively developed. However, agricultural practices in the mid-segments have severely accelerated sedimentation by manipulating riparian habitat. The tidal segment is classified as TW-1 waters, the basin above Crosswicks Mill Dam is

classified as FW-2 waters, and Colliers Mills Wildlife Management Area located in Ocean County is classified as FW-1 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Several lakes and minor impoundments are contained in the basin, most being old dammed millponds constructed during the early 1800's. Major lakes include Gropp Lake, Conines Millpond, Imlaystorm Lake, Oakford Lake, Brindle Lake, Spring Lake and Cookstown Pond. Only Cookstown Pond and a portion of Oakford Lake are located in the study area. Mean lake depth is about five feet. Available data (DVRPC, 1977) indicate heavy phosphorous loading and eutrophic conditions in these waterbodies. Siltation and excessive aquatic plant growth are characteristic. Phytoplankton levels may be exceptionally high during the summer. Stocking in the basin is limited to Imlaystorm Lake (i.e., largemouth bass).

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevations are generally under 100 feet. The basin is characterized by a series of gently dipping beds of clay, silt, sand and gravel.

Crosswicks Creek

Although Crosswicks Creek Marsh is biologically productive and supports a variety of flora and fauna, lands adjacent to the mainstem are developed. Residential areas, industry and commercial development have encroached upon or replaced limited riparian habitat. Headwater regions of the study area are also characterized by accelerated development. Only mid-segments of the basin contain natural conditions.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple, and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Dominant vegetation in Crosswicks Creek Marsh consists of wild rice, yellow water lily and common reed. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

Early surveys by Fowler (1920) indicate that diverse fish populations, including American shad and striped bass, were supported by Crosswicks Creek. The watercourse still supports several species of fish, although

anadromous runs of alewife are restricted due to sewage discharge and fish kills have occurred. Spawning runs of American shad no longer exist (Zich, 1977). Overall, fish species composition is diverse and includes resident, anadromous and several introduced species (e.g., carp, goldfish, channel catfish, bluegill, black crappie, largemouth bass). Recent sampling data are listed in Appendix B, Table 2. Additional species collected from small tributaries (Hastings, 1977) include fallfish, blacknose dace, creek chub, satinfin shiner and tessellated darter.

2. Wildlife

Portions of the tidal segment contain habitat that supports a wide variety of aquatic and terrestrial organisms. In addition, wetland vegetation (e.g., wild rice, yellow water lily and cattail) provides food and cover for many wildlife species. In Crosswicks Creek Marsh, seventy-three avian species have been observed, with an additional 24 species expected during the breeding season (Academy of Natural Sciences, 1975). This area also provides desirable habitat for muskrats, mice and Norway rats. Norway rats may be serious nest predators in the marsh. Wildlife species that may occur in the basin are given in Appendix C.

Crosswicks Creek

Upstream from the tidal segment, wildlife habitat has been modified by encroaching development. Similar, the headwater regions are undergoing accelerated development. Desirable habitat still exists along the mid-segments. This mid-segment region, however, is not within the study area.

C. Threatened or Endangered Species

The bald eagle, a Federally endangered species and the osprey, a State endangered species, are reported to occur in the basin. Neither species is resident and only occurs as a transient. There is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.). No Federally endangered or threatened flora are known to occur in the basin.

D. Important and Unique Habitat

The Crosswicks Creek Marsh area supports a variety of aquatic and terrestrial species. This area, including natural riparian habitat, undisturbed terrestrial habitat adjacent to abandoned fields, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish should be protected from further degradation.

Figure 3a. Headwater tributary north of Georgetown.

Figure 3b. Mainstem segment south of Bordentown.

Blacks Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Blacks Creek is located in northern Burlington County and has a drainage area of approximately 43 mi^2. The actual topographic divide incorporates a small area in Monmouth County but does not involve surface waters. In 1970 this area supported a population of approximately 10,000 people. The basin is composed of two major segments, the main stem and Bacons Run. The main stem of Blacks Creek flows for approximately 6.6 miles before draining into the Delaware River. Bacons Run contains the southern headwater region and flows for about 4.7 miles before its confluence with the main stem. Fern Run, a small second order tributary, flows into Bacons Run. The channel is tidal for only one mile because a dam near Highway 130 creates a barrier.

Land use in the basin is predominantly agriculture, containing some of the most productive soils in Burlington County. Suburban development, however, is competing for this land and becoming more prevalent. The tidal portion of the watercourse flows through Bordentown and is characterized by heavy

suburban/industrial development.

b. Water Quality: Urban concentrations located at the mouth of the watercourse have a direct, adverse influence on water quality. EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe problems with fecal coliform, TP, and NH_3-N in the tidal segment.

Overall, violations of water quality standards (as established by the 208 Regional Water Quality Management Program) stem from six known point source discharges on Blacks Creek. In addition to two municipal, three non-municipal and one industrial point source discharges, site-specific non-point sources include a waste lagoon and a landfill. Although water quality is generally good in upstream reaches, violations of TP standards result from septic system effluent and agricultural runoff. Sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area and downstream.

c. Lotic: Blacks Creek receives a number of tributaries (including irrigational ditching for agricultural purposes) as it flows out of its southern

headwater region. In the northern headwater region, additional diking for irrigation purposes has created several impoundments, influencing the flow regime, water temperature, channel characteristics and the overall stream ecosystem. Further downstream from the headwaters, other agricultural practices, including the removal of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through these areas. In undisturbed reaches, substrate consists mostly of mud, sand and gravel. Some headwater regions contain bog iron.

Above the tidal segment the channel averages one foot or less in depth and is approximately eight feet wide. In the tidal segment, mean depth averages about three feet and mean width ranges from 30 to 40 feet. The tidal segment is classified as TW-1 waters while the basin above the dam is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Several small farm ponds and shallow impoundments including Kuser Pond, Colliers Pond and

Blacks Creek

Wallace Millpond are contained in the basin. Mean lake depth is approximately five feet. Agricultural practices and septic system-related problems result in heavy phosphorous loading, accelerating the eutrophic process. Siltation and aquatic plant growth (e.g., bladderwort, some watermilfoil, cattail) are characteristic. Phytoplankton levels may be exceptionally high during the summer.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel, clay and marl.

The tidal segment of the basin is highly developed, containing little riparian habitat. The headwater reaches consist of agricultural/forested area. However, abandoned agricultural land is rapidly being committed to suburban development.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. American beech is the dominant species in some stands.

Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse communities are found on abandoned fields during various successional stages. Common pioneer species include grasses and sedges, goldenrod, blackberry, eastern redcedar, gray birch, sumac, poison ivy, red maple, sassafras, and black cherry. Black walnut will grow well on good site conditions (i.e., deep, rich, moist soils) in this area. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

Blacks Creek supports limited fish populations. Anadromous runs of blueback herring and alewife are restricted due to sewage discharge in the tidal segment where fish kills are common. Spawning runs of American shad no longer exist (Zich, 1977). Overall, species composition includes resident, anadromous and several introduced species (e.g., carp, goldfish, black crappie, bluegill sunfish, green sunfish and largemouth bass). Recent sampling data are presented in Appendix B, Table 3a-3b. Additional species collected in the northern headwater region (Hastings, 1977) include golden shiner, satinfin shiner, blacknose dace, creek chubsucker and tessellated darter.

Blacks Creek

2. Wildlife

Existing riparian buffer zones along urbanized areas support little habitat for a viable wildlife population. However, development creates an environment that supports urban species, including gray squirrel, Norway rat, common crow, robin, starling, house sparrow, dark-eyed junco and snapping turtle.

Agriculture is the primary land use in the upstream segments. When abandoned, these areas support various vegetational stages of succession and provide food and cover for many wildlife species.

Marshes, swamps and meadows are reported (Rogers and Golden, 1976) along the headwater reaches, particularly in the northern headwater region. When naturally occurring, these habitats support a great diversity of wildlife. Wildlife species that may occur in the basin are given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Blacks Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

Blacks Creek

D. Important and Unique Habitat

The most ecologically important areas within the basin are found in upstream and headwater regions. Swamps, marsh and natural riparian habitats support diverse communities of flora and fauna. These areas, including undisturbed, terrestrial, riparian, stream and nursery habitat supporting anadromous fish should be protected from further degradation.

Figure 4a. Headwater tributary east of Columbus.

Figure 4b. Mainstem segment near Roebling.

Crafts Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Crafts Creek forms a small basin located in northern Burlington County and has a drainage area of approximately 13 mi^2. Numerous unnamed perennial and intermittent tributaries are located along the main channel which flows for approximately 11 miles to the Delaware River. The channel is tidal for only one-half mile because a dam near Highway 130 creates a barrier.

Principal land use is agriculture, consistent with the Blacks Creek basin located to the north. As in the Blacks Creek basin, suburban development is competing for the land and is becoming more prevalent. The tidal portion of the watercourse flows adjacent to industrialized areas.

b. Water Quality: There is one known point source discharge of pollution in the Crafts Creek basin. In addition, site-specific non-point source discharges include a landfill and a lagoon. EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate TP and fecal coliform problems. In addition, moderate violations of pH standards are reported. These violations of water quality standards (as established by the 208 Regional Water

Quality Management Program) of TP and fecal coliform stem from septic tank effluent and agricultural runoff. Sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream.

c. Lotic: Crafts Creek receives a number of tributaries as it flows out of its headwater regions. Downstream, agricultural practices, including the removal of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. However, some downstream stretches still contain natural riparian habitat. Substrate conditions have been altered as the stream flows through agricultural areas. In undisturbed reaches, substrate consists mostly of mud, sand and gravel. In headwater reaches, the channel averages one foot or less in depth and is approximately six feet wide. In the tidal segment mean depth averages about three feet and mean width ranges from 100 to 300 feet. The substrate here is primarily mud. The tidal segment is classified as TW-1 waters, while the basin above the dam is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

Crafts Creek

d. Lentic: Only a few small farm ponds and shallow impoundments, including Carslake Pond, are contained in the basin. Mean lake depth of these water bodies is approximately four feet. Septic system-related problems and agricultural runoff are accelerating the eutrophic process in these impoundments. Siltation and aquatic plant growth (e.g., pondweed, bladderwort, cattail) are common. Phytoplankton levels may be exceptionally high during the summer. Previous State stocking consisted of bluegill and pumpkinseed sunfish in Carslake Pond.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. The topography ranges from nearly level to steep. Elevations are generally under 100 feet. Soil types consist of unconsolidated sand, gravel, clay and marl.

The tidal segment of the basin flows adjacent to an industrialized area. Much of the natural riparian habitat has been impacted by human activity. In comparison, upstream segments consist of agricultural/forested areas, including abandoned farmland. However, these relatively undisturbed areas are being lost to expanding suburban development.

Crafts Creek

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. American beech is the dominant species in some stands. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse plant communities in various successional stages are found on abandoned agricultural fields. Common pioneer species include grasses and sedges, goldenrod, blackberry, sumac, eastern redcedar, gray birch, poison ivy, red maple, sassafras and black cherry. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

Crafts Creek supports limited fish populations and water quality problems in the tidal segment may restrict anadromous fish. No anadromous clupeid spawning runs have been confirmed (Zich, 1977). Overall, species composition includes resident, anadromous and several introduced species (e.g., carp, bluegill sunfish, largemouth bass). Recent sampling data are listed in Appendix B, Table 4. In addition to this list, bluegill

Crafts Creek

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. American beech is the dominant species in some stands. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse plant communities in various successional stages are found on abandoned agricultural fields. Common pioneer species include grasses and sedges, goldenrod, blackberry, sumac, eastern redcedar, gray birch, poison ivy, red maple, sassafras and black cherry. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

Crafts Creek supports limited fish populations and water quality problems in the tidal segment may restrict anadromous fish. No anadromous clupeid spawning runs have been confirmed (Zich, 1977). Overall, species composition includes resident, anadromous and several introduced species (e.g., carp, bluegill sunfish, largemouth bass). Recent sampling data are listed in Appendix B, Table 4. In addition to this list, bluegill

sunfish and tessellated darter have been collected (Hastings, 1977) in Crafts Creek.

2. Wildlife

The urbanized portion of the basin does not support a viable wildlife population. The pressure of residential, commercial and industrial development will extirpate intolerant species. However, this development creates an environment suitable for urban-type wildlife species (e.g., gray squirrel, Norway rat, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C. The forested/agricultural areas, especially abandoned farmland, provide the best overall wildlife habitat in the basin. Moreover, vegetational transition zones between forest and various successional stages provide "edge" for wildlife to feed, breed and for territorial requirements.

C. Threatened or Endangered Species

Federally-designated threatened or endangered species of flora and fauna are not known to occur in the Crafts Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers.

Crafts Creek

comm.).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

Figure 5a. Headwater tributary northeast of Jobstown.

Figure 5b. Mainstem segment east of Burlington.

Assiscunk Creek

A. Habitat Description

1. Aquatic:

a. Description of Basin: Assiscunk Creek is located in northern Burlington County and has a drainage area of approximately 45 mi^2. In 1970 this area supported a population of approximately 8,000 people. The basin is composed of two major segments, the main stem and Barkers Brook. The main stem, including Annaricken Brook in the northern headwater region, flows for approximately 15 miles before draining into the Delaware River. Barkers Brook contains the southern headwater region and flows for about nine miles before its confluence with the main stem. The channel is tidal for approximately one mile.

Land use in the basin is primarily agriculture, consistent with adjacent basins and supported by the productive soil characteristics of the region. similarly, suburban development is competing for this land and becoming more prevalent. The tidal segment of the watercourse flows through Burlington and is characterized by heavy urban/suburban development.

Assiscunk Creek

b. Water Quality: NPS STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe TP and fecal coliform problems. In addition, moderate violations of pH are reported but primarily influenced by acidic soil conditions. Violations of water quality standards (as established by the 208 Regional Water Quality Management Program) of TP and fecal coliform stem primarily from septic tank effluent with phosphorous contributions accelerated from agricultural runoff. Overall, the basin contains five known point source discharges, three landfills and two industrial lagoons. Sedimentation is especially severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream.

Benthic samples show aquatic earthworms to be the most common macroinvertebrate species in the main stem (Craighead, 1971). These animals are characteristic of organic enrichment and low oxygen concentrations.

c. Lotic: Assiscunk Creek receives a number of tributaries, including irrigational ditching, as it flows out of the headwater regions. Downstream, other agricultural practices, including the removal

of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through these areas. In undisturbed reaches, substrate consists mostly of mud, sand and gravel.

Above the tidal segment the channel averages one foot or less in depth and is approximately 10 feet wide. Summer low flow periods are common. However, developments in the floodplain have accelerated storm runoff and have increased peak discharges. In the tidal segment, mean width ranges from 40 to 60 feet and mean depth about three feet. The tidal segment is classified as TW-1 waters and the remainder of the basin is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Only a few small farm ponds and shallow impoundments, including Saylors Pond, are contained in the basin. Mean lake depth is approximately five feet. Saylors Pond, located in the headwaters of Barkers Brook, has a water surface area of about two acres. Due to the soil conditions in this region, waters are normally acidic. Septic system-

related problems and agricultural runoff are accelerating the eutrophic process in these impoundments. Siltation and aquatic plants are common. Aquatic vegetation consists of bladderwort, arrowhead, elodea, waterlily, and pondweed. Phytoplankton levels may be exceptionally high during the summer.

2. Terrestrial:

The basin lies within the Inner Coastal Plain of New Jersey with elevations generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel, clay and marl.

A portion of the main stem, including the tidal segment, is highly developed, and only minimal riparian habitat remains. Upstream segments consist primarily of agricultural areas where riparian habitat has been manipulated along many sections of the watercourse. Furthermore, abandoned agricultural land is rapidly going into suburban development.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, ironwood,

sassafras, spicebush and various herbaceous communities. Diverse communities are found on abandoned agricultural fields during various successional stages. Common pioneer species include grasses and sedges, goldenrod, blackberry, eastern redcedar, gray birch, sumac, poison ivy, red maple, sassafras and black cherry. A more detailed vegetational list is presented in Appendix A.

B. Species Composition

1. Fishes

Assiscunk Creek supports limited fish populations. Water quality problems in the tidal segment restrict anadromous runs and fish kills are common. No anadromous clupeid spawning runs have been confirmed (Zich, 1977). Overall, species composition includes resident, anadromous and introduced species (e.g., carp, largemouth bass, black crappie). Recent sampling data are listed in Appendix B, Table 5. Additional species collected in the northern headwater region (Hastings, 1977) include chain pickerel, creek chubsucker, brown bullhead, pirate perch, bluespotted sunfish, swamp darter and tessellated darter.

2. Wildlife

Natural riparian habitat along the tidal segment has

been severely manipulated by development. The existing cover supports some shore birds, small mammals, reptiles and amphibians. The pressure of residential, commercial and industrial development will extirpate intolerant species. However, this situation creates an environment for urban-type wildlife species (e.g., gray squirrel, Norway rat, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C. The forested/agricultural areas, especially abandoned farmland, provide the best overall wildlife habitat in the basin. Moreover, vegetational transition zones between forest and various successional stages provides "edge" for wildlife to feed, breed and for territorial requirements.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Assiscunk Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barron; Zich, pers. comm.).

Assiscunk Creek

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

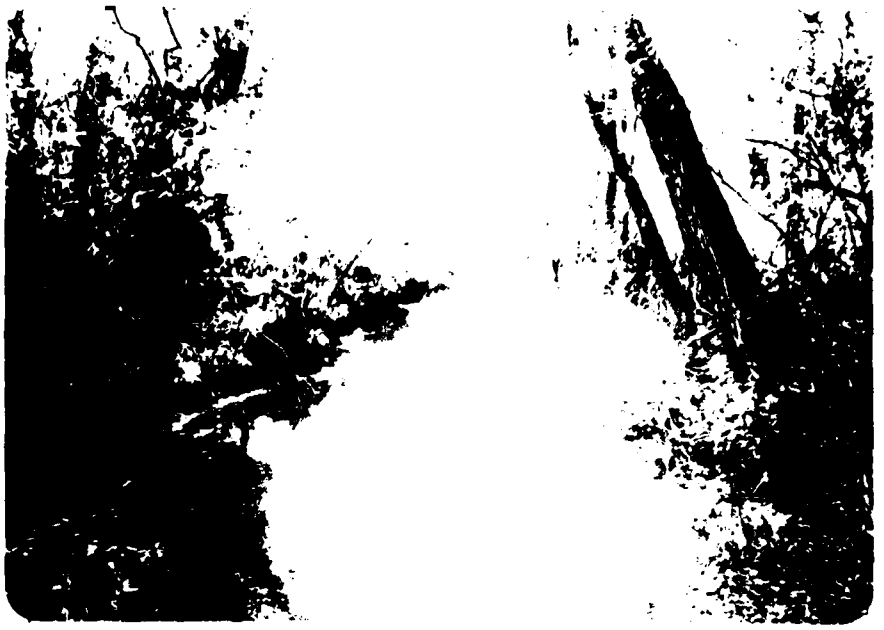


Figure 6a. Headwaters, South Branch tributary southeast of Friendship.

Figure 6b. Mainstem, North Branch tributary north of Ewansville.

Rancocas Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Rancocas Creek is one of the largest basins in the study area. Overall, the watercourse drains an area of approximately 360 mi^2 within Burlington, Ocean and Camden Counties. Approximately 316 mi^2 are in the study area with the major portion located in Burlington County. In 1970 this area supported a population of approximately 153,000 people.

The watercourse is composed of three major segments, the tidal/main stem, the north branch and the south branch (the southwest branch is a sub-basin of the south branch). The north branch flows for about 23 miles and has a drainage area covering 142 mi^2. The south branch flows for about 20.5 miles and has a drainage area covering 187 mi^2. The main stem flows for approximately 7.5 miles before draining into the Delaware River. The watercourse is tidal for about 14 miles.

Land use in the basin is diverse and ranges from highly industrialized to the forested Pine Barrens. Approximately 20% of the basin is characterized by suburban/industrial development. Developed areas

inc ·de Mount Holly on the north branch, a section of the northern headwater region near Fort Dix and a section of the southwestern headwater region located in Medford Lakes. Approximately 26% of the land area is used for agriculture, primarily in middle portions of the basin. About 54% of the basin is forested, mostly in the eastern and southern portions. Suburban development, however, is competing for agricultural/forested land and is becoming more prevalent.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe TP, pH and fecal coliform problems. Data also show moderate DO and NH_3–N problems. Violations of water quality standards (as established by the 208 Regional Water Quality Management Program) stem primarily from 12 municipal, 13 non-municipal and three industrial point source discharges located in the basin. In addition, there are site-specific non-point sources from 14 landfills, two industrial lagoons and three animal feedlots leaching into the water system. Fecal coliform and TP problems are also influenced by septic tank effluent with phosphorous contributions accelerated by agri-

cultural runoff. Investigations (DVRPC, 1977) show that urban runoff is increasing organic, nutrient and heavy metal concentrations in the waterways.

Benthic samples show aquatic earthworms to be the most common macroinvertebrate species in the north branch near Mount Holly (Craighead, 1971). These animals are characteristic of organic enrichment and low oxygen concentrations.

c. Lotic: Rancocas Creek incorporates numerous tributaries as it flows out of its headwater regions. The northern headwater region is composed of two major tributaries, the north branch, flowing out of Fort Dix and the Greenwood branch, flowing out of Lebanon State Forest. Headwaters originating in Lebanon State Forest and adjacent lands, except for isolated cranberry and blueberry culture, are relatively undisturbed as they flow through pitch pine stands and Atlantic white-cedar swamps. Throughout the midsection of the basin, agricultural practices, including the removal of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Although substrate naturally con-

sists of sand and gravel, bottom conditions have been altered in these disturbed reaches. Similar to the north branch, the southern headwaters originate in primarily forested area. The southwestern headwater region flows out of the highly suburban Medford Lakes Area.

Being a large basin, the Rancocas naturally illustrates considerable variation in bank and channel characteristics as it flows toward the Delaware River. Headwater reaches average three feet or less in depth and are approximately 10 feet wide. In the main stem, mean depth is about 13 feet while mean width ranges from 400 to 800 feet. Average discharge in the main stem is approximately 150 cfs. The tidal segment is classified as TW-1 waters, Lebanon State Forest and the Pasadena Wildlife Management Area are classified as FW-1 waters, the South Branch, including Jade Run, is classified as FW-Central Pine Barrens waters and the remainder of the basin is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

The floodplain along Rancocas Creek is extensive and contains numerous tidal beaches and flats. A Corps of Engineers floodplain information study of Rancocas

Creek (1967) concludes that there are risks involved with floodplain development and that there is a need to control such development. In the study report the U.S. Fish and Wildlife Service recommends that "those wetland areas found to be within the floodplain should be preserved either by zoning or by public ownership. . ." We see no reason to revise that assessment. Nevertheless, floodplain development continues.

d. Lentic: The basin contains numerous named and unnamed ponds and lakes, several of which originated as cranberry bogs. To analyze the trophic state of these impoundments, three lakes (i.e., Mirror Lake, Smithville Lake, Vincentown Mill Pond) were selected on the basis of surrounding land use (DVRPC, 1977). Mirror Lake, influenced by urbanization, contains approximately 150 acres of water surface area and has a mean depth of 15 feet. Smithville Lake, influenced by surrounding forest, contains approximately 25 acres of water surface area and has a mean depth of eight feet. Vincentown Mill Pond, influenced by agricultural practices, contains approximately eight acres of water surface area and has a mean depth of six feet. Although all three study lakes were classified eutrophic, especially

high TP levels were recorded for Mirror Lake and Vincentown Mill Pond. Human activities in the basin, including septic systems, agricultural practices and urban runoff are accelerating the eutrophic process. Excessive aquatic plant growth, including pondweed and watermillfoil, are common. Phytoplankton levels may be exceptionally high during the summer.

Several of the impoundments located in the Pine Barrens illustrate dystrophic characteristics and bog-type habitat. Many bogs originated from disturbances, including mining of bog ore and wildfire burning deep into the organic soil of a swamp during extreme drought.

Trout stocking in the basin is limited to Crystal Lake in Willingboro and Woolman's Lake in Mount Holly (i.e., adult rainbow trout). Previous State stocking consisted primarily of largemouth bass/sunfish in several of the impoundments, including Smithville Lake. Overall, chain pickerel, largemouth bass and white catfish are the major fish species supported by these waterbodies.

2. Terrestrial

The basin lies within the physiographic provinces of both

the Inner Coastal Plain and the Outer Coastal Plain. The topography of the basin is generally flat or slightly undulating with increasingly less relief near the headwaters. Elevations are generally under 100 feet. Soil types consist of sand, clay and gravel, with sandier conditions in the Outer Coastal Plain. A substantial portion of the basin can be characterized as suburban. Forested Pine Barren areas are located in the eastern and southern portions of the basin. Isolated cranberry and blueberry culture are common landscape features in the Pine Barrens.

The basin contains three major types of vegetational community structure. A mixed oak forest type prevails in the western portion, mixed oak-pine forests are contained in the middle segments and the Pine Barrens are located in the eastern and southern portions. Associates of the mixed oak forest type vary with site but normally include American Beech, yellow-poplar, red maple and various hickories. Understory vegetation consists of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Transition zones of mixed oak-pine forest types occur as pitch pine becomes more prevalent in the stand. Associates of the mixed oak-pine forest type vary with site but normally include pitch pine, shortleaf pine, scarlet, white, chestnut, black-

jack, post, black and scrub oaks. Although pitch pine stands are most characteristic of the Barrens, several forest types are recognized (McCormick, 1970). These forest types include Atlantic white-cedar swamps, maple-gum-magnolia swamps, pitch pine lowland forests on moist sites and pine-blackjack oak, pine-oak, and oak-pine on dry or upland sites. Herbaceous plant communities vary with each of these different site conditions. A more detailed vegetational list is given in Appendix A.

B. Species Composition

1. Fishes

Rancocas Creek supports several species of fish. Overall, species composition is diverse and includes resident, anadromous and introduced species (e.g., carp, goldfish, bluegill sunfish, largemouth bass). However, spawning runs of American shad are no longer present (Zich, 1977). Recent sampling data are presented in Appendix B, Table 6a-6f. Additional species collected in the south branch (Hastings, 1977) include golden shiner, brown bullhead, redfin pickerel, bluespotted sunfish and tessellated darter. Fish populations supported by the headwaters reaches in the Pine Barrens are composed of species tolerant of acidic waters. Species collected in an unnamed tributary to the main

stem include redfin pickerel, swallowtail shiner and creek chubsucker.

2. Wildlife

The mainstem wetland portion of the basin, particularly the peninsula of tidal marsh formed by the confluence of the north and south branches, is an important area for wading birds, shore birds, raptorial species and migratory waterfowl. However, in developed areas the pressure of residential, commercial and industrial activities has resulted in the extirpation of some species, leaving as residents urban tolerant wildlife such as gray squirrel, Norway rat, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco and snapping turtle. A more detailed list of wildlife species that may occur in the basin is given in Appendix C. In general, the forested/agricultural areas, abandoned farmland, marshes, and undisturbed sections of the Pine Barrens provide the best wildlife habitat in the basin.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of fauna are not known to occur in the Rancocas Creek basin. However, two species, the Pine Barrens treefrog (proposed) and the bog turtle, which do occur in the Atlantic white-

cedar swamps of the Barrens are classified by the State of New Jersey as endangered. The Pine Barrens treefrog has been nominated for the Federal Endangered Species List. There is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.). Further, Knieskern's beaked-rush has also been nominated for the Federal Endangered Species List and is reported to occur in the Pine Barrens.

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse, wetlands, nursery habitat supporting anadromous fish, the Pine Barrens, and the Pine Barrens aquifer. These areas should be protected from further degradation. The Pine Barrens and associated Atlantic white-cedar swamps are especially important since their unique habitats support a diversity of fauna and flora. A considerable amount of this area is currently proposed for development.

The 23 mile segment of the Rancocas from Browns Mills downstream to its confluence with the Delaware River has been suggested for study and consideration by the State of New Jersey as a wild and scenic river under the Wild and Scenic Rivers Act (P.L. 90-542).

Figure 7a. Pompeston Creek south of Cinnaminson.

Figure 7b. Swede Run south of Delran.

Pompeston Creek/Swede Run

A. Habitat Description

1. Aquatic

a. Description of Basin: This basin is located in Burlington County and is composed of Pompeston Creek and Swede Run, two small separate tributaries draining into the Delaware River. Approximately one-half mile of both sub-basins is tidal. Collectively, the basin is usually delineated as the Pompeston watershed and has a drainage area of approximately 19 mi^2.

The Pompeston sub-basin is located south of Swede Run. This second order tributary originates in Moorestown and is approximately 5.3 miles in length. The watercourse flows through some minor impoundments and a tidal flat before discharging into the Delaware River. A substantial portion of the sub-basin has been developed.

Swede Run is also a second order tributary and flows for approximately 5.7 miles. The headwater region is located outside of the developed portion of Moorestown. The stream flows through some agricultural/forested areas and through several shallow impoundments before discharging into the Delaware River. Similar to Pompeston Creek,

suburban development has occurred over a substantial portion of the sub-basin.

b. Water Quality: Although 208 Water Quality Data (DVRPC, 1977) include Swede Run and Pompeston Creek in the Pennsauken drainage basin, no data are given that specifically relate to these watercourses. However, there are three known point source discharges within the Pompeston/Swede basin. One industrial discharge is located on Swede Run and two municipal sewage treatment plants are located on Pompeston Creek. Further, there are four landfills located in this sub-basin which can be considered site-specific non-point sources of pollution. Although no current water quality data are available, it is reasonable to expect that violations of DO, pH, TP, NH_3-N and fecal coliform standards occur, especially in Pompeston Creek. It should be noted that recent field observations, including fish sampling, indicate that upstream sections of Swede Run have good water quality and support viable fish populations.

c. Lotic: The headwater regions of both watercourses flow toward the Delaware River through remnant agricultural/forested areas and expanding suburban

developments. Mean width of both channels is approximately eight to 10 feet and mean depth appr - mately eight to 18 inches. Intermittent tributaries are located along the perennial channel of both streams. Substrate consists of boulders, gravel and sand. Arrowhead and pondweed are found along Swede Run. A stretch of Swede Run at Highway 130 has been channelized, and riparian vegetation has been eliminated from several stretches in the area. The tidal segments of both sub-basins are classified as TW-2 waters while the remainder of the basin is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Only a few small, shallow impoundments are contained in each sub-basin. Mean lake depth is approximately five feet. Sewage outfalls and other types of organic pollution are accelerating the eutrophic process in these impoundments. Originally a gravel pit, Swede Run Lake, located near the Delaware River, has a depth of 30 feet.

2. Terrestrial

Topography in the basin is nearly level to gently sloping. Elevations are generally under 100 feet. Each of the mainstem areas is highly urbanized. Pompe-

Pompeston Creek/Swede Run

ston Creek is almost entirely developed to the headwaters with little protective riparian habitat. The headwater region of Swede Run contains agricultural/forested areas but this land is rapidly being lost to development. Soil types consist of sand, gravel, clay and marl.

The wooded areas of the basin consist primarily of a mixed oak forest type. Associates vary with site but normally include American beech, yellow-poplar, sweetgum, blackgum, red maple and several species of hickory. Understory vegetation may contain dogwood, ironwood, sassafras, spicebush, black haw, arrowwood and various herbaceous communities. A more detailed vegetation list is given in Appendix A.

B. Species Composition

1. Fishes

Upstream sections of Swede Run support viable fish populations (See Appendix B, Table 7b). Additional species collected in Swede Run (Hastings, 1977) include swallowtail shiner, creek chubsucker, chain pickerel and redear sunfish. Further, Swede Run Lake is reported to support black crappie, white perch, brown bullhead, several species of sunfish and possibly alewife. Pompeston Creek, in comparison, shows signs of degradation. Species

composition is not as diverse as Swede Run and consists primarily of goldfish, killifish and sunfish species (see Appendix B, Table 7a). In addition, mummichog and golden shiner are reported (Hastings, 1977).

2. Wildlife

Wildlife resources in the basin differ somewhat from the mainstem to the headwater regions. Tidal wetlands at the mainstem are important to the wading birds, shore birds, raptorial species and migratory waterfowl. Inland of the tidal areas the pressure of residential, commercial and industrial development has forced many wildlife species into remnant sections of the basin. Species unable to tolerate this developmental pressure will be extirpated. This situation creates an environment for urban-type wildlife species (e.g., gray squirrel, Norway rat, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). Wildlife species that may occur in the basin are given in Appendix C. The forested/agricultural headwater region provides the best overall wildlife habitat in the basin. These lands provide "edge" for wildlife to feed, breed and for territorial requirements; however, they are rapidly being lost to development.

Pompeston Creek/Swede Run

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Pompeston Creek/Swede Run Basin.

D. Important and Unique Habitat

The undisturbed tidal portion of these watercourses provides a food source for a diversity of avian fauna. Sections of Swede Run also support viable biotic communities. Due to developmental pressures, these areas should be protected from further degradation.

Figure 8a. Headwater tributary east of Maple Shade.

Figure 8b. Mainstem segment southwest of Cinnaminson.

Pennsauken Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Pennsauken Creek is located in Burlington and Camden Counties. The basin drains an area of approximately 33 mi^2. In 1970, this area supported a population of approximately 66,500 people. The basin is composed of two major segments, the north and south branch. The north branch, located in Burlington County, has a drainage area of 15 mi^2 and flows for approximately 7.3 miles. The south branch (Camden-Burlington County border) has a drainage area of 14 mi^2 and flows for approximately 6.5 miles. The main stem flows for 3.3 miles before its confluence with the Delaware River. The channel is tidal for approximately 6.5 miles in the north branch and six miles in the south branch. The Strawbridge Lake Dam creates a tidal barrier on the north branch.

Land use in the basin is predominantly suburban and approximately 50% of the total land area is developed. Although agricultural/forested areas exist in the headwater regions, suburban development is competing for this land and becoming more prevalent. The main stem and a substantial portion of the north branch

are characterized by heavy urban development.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe water quality problems in the basin. Water quality violations (as established by the 208 Regional Water Quality Management Program) include DO, NH_3-N, TP, fecal coliform and pH. Overall, these violations stem from 10 municipal and one industrial point source discharges. Sewage comprised 20 to 60% of the flow rate in both the north and south branches during low flow periods (Hydroscience, 1976). In addition, three landfills are located within the basin that may be considered site-specific, non-point source discharges. Sedimentation is severe in remaining agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area and downstream. Associated runoff from suburban and agricultural areas greatly increases concentrations of organic, sediment and sediment-related pollutants.

Organisms tolerant of organic pollution are expected to occur in Pennsauken Creek, including rat-tailed maggots, sewage fly larvae, midge larvae and aquatic earthworms.

Pennsauken Creek

c. Lotic: The headwater regions are composed of several intermittent tributaries that flow primarily through agricultural/forested areas. Land use, particularly agricultural practices and development have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through these areas. In undisturbed reaches substrate consists mostly of sand and gravel.

Above the tidal segment the channel averages one foot or less in depth and is approximately six feet wide. Summer low flows are common. In the tidal segment mean depth averages two feet and mean width from 40 to 80 feet. Wetland areas along the tidal segment contain communities of spatterdock, wildrice, arrow arum and yellow water lily. The tidal segment is classified as TW-2 waters while the basin above the tidal segment is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Only a few small farm ponds and shallow impoundments are contained in the basin. Mean lake depth is approximately two feet. Strawbridge

Pennsauken Creek

Lake is the major impoundment in the basin, located on the north branch. Mean depth is five feet. The lower portion of the lake is characteristic of water quality problems and siltation. Overall, associated runoff from suburban and agricultural areas are accelerating the eutrophic process in the impoundments. Siltation and aquatic plants are common. Aquatic vegetation consists of elodea, cattail, bladderwort and arrowhead. Phytoplankton levels may be exceptionally high during the summer.

Stocking programs have been terminated in the basin. Previous State stocking consisted of largemouth bass/sunfish in some of the farm ponds and trout in Strawbridge and Columbia Lakes.

2. Terrestrial

The basin lies within a highly populated region. The area is part of the Inner Coastal Plain; the elevation is generally under 100 feet and the soil consists of unconsolidated sand, gravel, clay and marl.

The impact of human activity adjacent to the main stem and the north branch is obvious with industrial, commercial and residential development. Much of the agricultural/forested acreage in the headwater regions

is now in or is proposed for development.

The existing vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse vegetational communities are found on abandoned agricultural fields during various successional stages. A more detailed vegetational list is presented in Appendix A.

B. Species Composition

1. Fishes

Due to the continued degradation of the aquatic habitat, Pennsauken Creek supports limited fish populations composed primarily of rough fish. Although alewife and blueback herring were sampled in the tidal segment during 1973 (U.S. Fish and Wildlife Service, Delaware River Basin Anadromous Fishery Project), a recent State anadromous fish inventory (Zich, 1977) did not confirm actual spawning runs in the basin. The tidal segment may be used as temporary holdover to avoid pollution problems in the Delaware River. Recent sampling data is presented in Appendix B, Table 8a-8b. In addition

to this listing, American eel, chain pickerel, black crappie, brown bullhead, silvery minnow and mummichog have been collected (Hastings, 1977).

2. Wildlife

Development influence throughout a substantial portion of the basin decreases the potential for healthy wildlife populations. However, this same influence creates an environment conducive to urban wildlife species (e.g., gray squirrel, Norway rat, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). Wildlife species that occur in the basin are listed in Appendix C. The agricultural/forested areas in the headwater regions provide the best overall wildlife habitat in the basin. These remaining areas provide "edge" for wildlife to feed, breed and for territorial requirements. However, these relatively undisturbed areas are being lost to expanding suburban development.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Pennsauken Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may

occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

D. Important and Unique Habitat

Undisturbed terrestrial habitat adjacent to abandoned fields, wetlands and any natural riparian habitat along the watercourse can be termed desirable. Although a major portion of the basin is degraded, existing natural habitat should be protected from further exploitation.

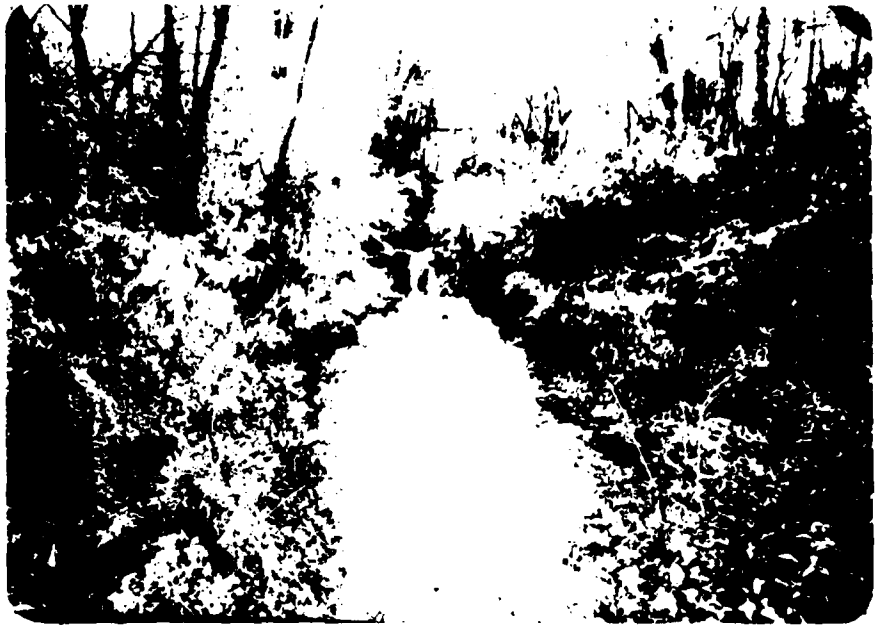


Figure 9a. Headwater tributary east of Haines Corner.

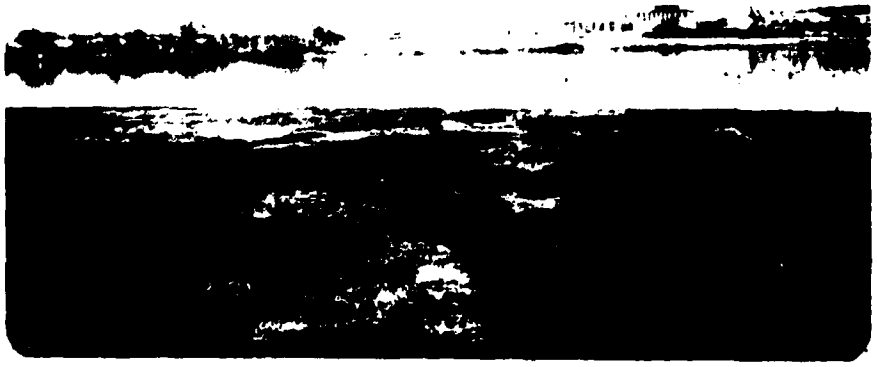


Figure 9b. Mainstem segment in Camden.

Cooper River

A. Habitat Description

1. Aquatic

a. Description of Basin: The Cooper River basin is located in Camden County and has a drainage area of approximately 41 mi^2. In 1970 this area supported a population of 75,000 people. The main channel is tidal and partially channelized for three miles, where the Cooper River Lake Dam creates a tidal barrier. This main channel plus the four-mile long Cooper River Lake flows for approximately 7.2 miles and has a drainage area covering about 11 mi^2. At the inflow of the lake the watercourse divides into a north and south branch. The north branch has a drainage area of 11 mi^2 and flows for approximately eight miles while the south branch has a drainage area of 19 mi^2 and flows for approximately nine miles. Although most of the headwater regions contain natural riparian habitat, downstream reaches are characterized by heavy suburban and industrial development, particularly along the south branch. The tidal portion of the river flows through the urban area of Camden.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate

Cooper River

severe water quality problems in the basin stemming from 15 municipal, three non-municipal and five industrial point source discharges. Further, there are site-specific non-point sources from seven landfills and one industrial lagoon leaching into the water system. Although the basin is sewered, the water quality of the headwaters is influenced by a substantial number of septic tanks. Data indicate moderate DO readings, severe fecal coliform, TP, and NH_3-N problems, and moderate to severe pH problems. According to the 208 Regional Water Quality Management Planning Program, DO levels are usually violated in portions of the basin during summer months.

Macroinvertebrate species normally found in a healthy aquatic environment are supported in most headwater regions. Species may include aquatic sowbugs, gill breathing snails, mayfly larvae and caddisfly larvae. However, organisms tolerant of organic pollution, including rat-tail maggots, sewage fly larvae and midge larvae are present downstream. The most common species reported in the basin are chironomid larvae (Craighead, 1971).

c. Lotic: The upstream reaches flow primarily through

agricultural/forested areas. These tributaries begin as shallow, fast-flowing reaches and become sluggish as the watercourse flows through lentic basins. Although flow rate naturally fluctuates, it is influenced here by the effluent from several treatment plants. Data recorded (Hydroscience, 1976) in the north branch show 4.5 of 10 cfs originating from two treatment plants. Similarly, in the south branch, 9.1 of 21 cfs originated from eight treatment plants. Depth, also a fluctuating variable, averages one foot in upstream reaches and four to nine feet in the tidal channel. Substrate consists mostly of sand. The tidal segment is classified as TW-2 waters and the basin above Cooper River Lake is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: The basin contains 10 major lakes plus minor impoundments. The major lake along the main stem is Cooper River Lake with depths ranging from three to seven feet. The south branch includes Hopkins Pond, Evans Pond, Kirkwood Lake, Linden Lake, Edgewood Lake, Bridgewood Lake, Silver Lake, Clement Lake and Woodland Lake. Mean depths range from one to six feet. Two of the larger impoundments, Kirkwood and Evans, have water surface areas

of approximately five acres.

Obviously, human activities in the basin have accelerated the eutrophication process and in some situations hypereutrophy exists. Phytoplankton levels may be exceptionally high during the summer.

Trout stocking in the basin is limited to Bridgewood, Rowands and Hopkins Ponds (i.e., adult rainbow and brown trout). Rowands Pond is a small impoundment upstream of Silver Lake. Hopkins Pond is also stocked with largemouth bass. Previous State stocking in the river consisted of channel catfish between 1958 and 1960.

2. Terrestrial

The basin lies within a highly populated region. This area is part of the Inner Coastal Plain; the elevation is generally under 100 feet and the soil consists of unconsolidated sand, gravel, clay and marl.

The impact of human activity adjacent to the river is obvious. Much of the agricultural/forested acreage is now in or is being sold for development purposes. Natural riparian habitat is continuously being replaced by development, leaving little, if any areas to serve as buffer zones along the waterways. Vegetational community structure consists primarily of a mixed oak

forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, sassafras, spicebush and various herbaceous communities. A more detailed vegetation list is given in Appendix A. Cooper River Park is manicured and provides little, of any, vegetation for the benefit of wildlife. Sycamore and pin oak are the predominant tree species.

B. Species Composition

1. Fishes

Continued degradation of the aquatic habitat has limited the diverse fish populations that once occurred in the basin. In addition, migratory routes for anadromous species have been blocked. Some of the more significant fish species collected by Fowler (1920, 1952) that no longer exist in the Cooper River system include the following: Atlantic sturgeon (1952), American shad (1920), brook trout (1920, 1952), Atlantic menhaden (1952), rock bass (1952), and striped bass (1952). This listing shows considerable contrast to the predominant fish species (i.e., goldfish, carp) that are currently supported by the Cooper River system. Fish species including banded, blackbanded, mud and bluegill

sunfish, yellow perch, chain pickerel, white catfish, yellow bullhead, black crappie and madtoms would be expected in sections of the basin. Recent sampling data are listed in Appendix B, Table 9a-9b.

2. Wildlife

The highly urbanized and industrial influence of the Cooper River decreases the potential for healthy wildlife populations. However, this same influence creates an environment conducive to urban wildlife species (e.g., gray squirrel, Norway rat, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). Resident mallards as well as some migrant waterfowl (resting only) are found along the waterway. Wildlife species that occur in the basin are listed in Appendix C.

The quality and, more importantly, the quantity of land being developed decreases the abundance of wildlife. Existing riparian buffer zones are inadequate to support viable aquatic and terrestrial ecosystems in the basin. This limitation alone restricts the numbers and diversity of wildlife found in the area. The greatest diversity of wildlife occurs in the remaining wooded areas of the headwaters. Bordering these wooded areas are minimal amounts of agricultural lands which create

ideal habitat situations, in that movement of resident wildlife is not entirely restricted.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Cooper River Basin.

D. Important and Unique Habitat

The headwater regions of the river can be termed desirable, due to seemingly never ending developmental encroachment. Although a major portion of the river is degraded, the headwater regions still contain natural habitat. Limited floodplain, wetland and/or woodland habitats can still provide opportunities for basin residents to observe wildlife in a relatively natural environment.

Figure 10a. Headwater Tributary in Haddon Heights

Figure 10b. Mainstem segment in Haddon.

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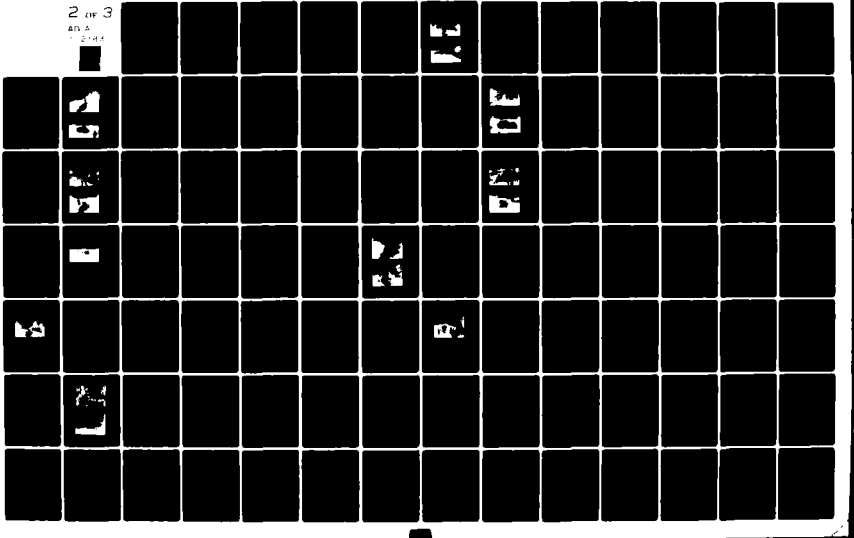

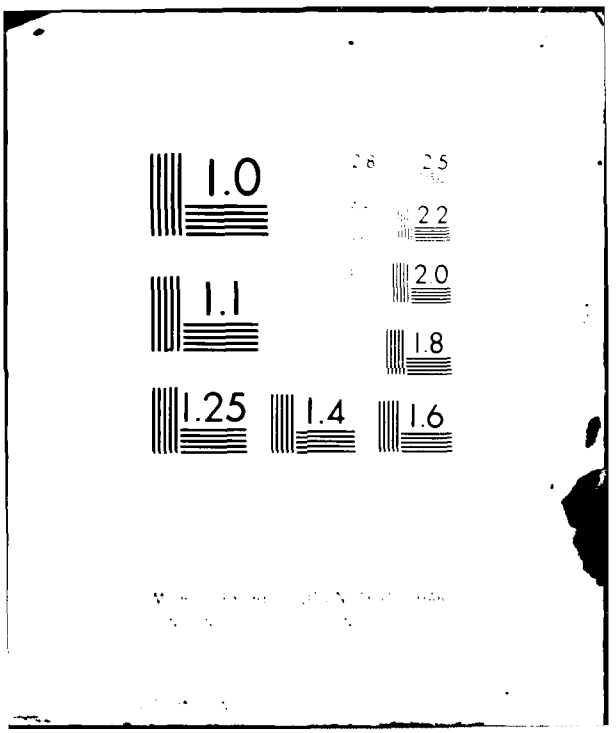
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Newton Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: The Newton Creek watershed is located in Camden County and has a drainage area of approximately 14.2 mi^2. The basin is composed of four major segments. The main stem flows for approximately 5.6 miles, from Crystal Lake in the headwater region to the Delaware River. Other segments consist of the 1.7 mile long north branch, the 3.6 mile long south branch and Peter Creek which flows for 1.4 miles from its headwaters to its confluence with the main stem. A large portion of the basin is tidal. Newton Creek is characterized by heavy suburban and industrial development. Other than some scattered tidal wetlands, little natural habitat remains along the watercourse.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe water quality problems in the basin. There are eight point source discharges along the watercourse, including six municipal sewage treatment plants. Four of the discharges are located along the south branch, two along the main stem and one each along the north branch and Peter Creek. Addi-

tional point sources consist of two water treatment facilities that discharge into the south branch. Further, there is a landfill located in the south branch sub-basin that may be considered a site-specific non-point source. According to standards established by the 208 Regional Water Quality Management Planning Program, data indicate moderate DO and pH violations and severe violations of TP, NH_3-N and fecal coliform. Since Newton Creek drains urbanized areas, the associated runoff greatly increases concentrations of organic, nutrient, sediment and sediment related pollutants.

Organisms tolerant of organic pollution are expected to occur in Newton Creek, including rat-tail maggots, sewage fly larvae and midge larvae.

c. Lotic: Since the basin is heavily urbanized, storm run-off directly influences flow rate. However, during low-flow periods, the presence of impoundments and tidal wetlands results in a sluggish discharge. All historically naturally-functioning stream ecosystems in this basin have been severely manipulated. The tidal segment is classified as TW-2 waters and the remainder of the basin is classified as FW-2 waters by the New Jersey Department of En-

vironmental Protection.

d. Lentic: The basin contains four shallow lakes: Newton, Crystal, Audubon and Haddon Lakes. Mean lake depth ranges from one to three feet. Human activities in the basin have accelerated the eutrophication process with heavy phosphorous loadings and in some situations hypereutrophy exists. Phytoplankton levels may be exceptionally high during the summer.

2. Terrestrial

The drainage area is entirely developed. The land within the drainage area shows little contrast in elevation or topography and has been completely altered by housing, commerce, industry and transportation arteries (i.e., railroads, major highways). Topography varies from an elevation of less than 10 feet (msl) along the north branch to [illegible]t (msl) throughout most of the rest of the drainage area. An elevation of 40 feet (msl) is reached at one point in the northernmost portion of the basin. Subsurface materials consist of recent alluvial and manmade fill deposits above cretaceous marine sediments.

Vegetated areas adjacent to Newton Creek consist pri-

marily of planted tree species, including scarlet oak, pin oak (predominant), red maple, willows, sycamore, and American beech. Natural understory vegetation in the area is almost non-existent. Newton Creek Park is manicured to the streambanks.

B. Species Composition

1. Fishes

Continued degradation of the aquatic habitat has limited the fishery resource in Newton Creek. Although no recent sampling data exists, species such as carp, goldfish, American eels, brown bullhead, golden shiner and some pumpkinseed sunfish probably occur. Degraded water quality makes it difficult for anadromous fish to utilize the watercourse. Fish kills are common.

2. Wildlife

The Newton Creek watershed is located in the Philadelphia-Camden Standard Metropolitan Area, in the heart of the developing East Coast Megalopolis. In a letter to the Philadelphia District, Corps of Engineers, dated December 5, 1963, this Service stated that fish and wildlife resources in the basin are of "negligible value". We see no reason to revise that assessment. Continuous development since 1963 has encroached on all portions

of the basin, leaving only urban tolerant wildlife species. Common urban wildlife found along Newton Creek include dark-eyed juncos, sparrows, starlings, domestic ducks, pigeons, sea gulls, snapping turtles, Norway rats, house mice, gray squirrels and migratory waterfowl (resting only). A more detailed list of wildlife species that may occur in the basin is found in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Newton Creek basin.

D. Important and Unique Habitat

Information gathered during recent field trips to the area supplemented by literature review indicates that this basin will not support viable aquatic and/or terrestrial ecosystems.

Figure 11a. Headwater tributary in Almonesson.

Figure 11b. Mainstem segment west of Runnemede.

Big Timber Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Big Timber Creek is located in Camden and Gloucester Counties. The basin drains an area of approximately 63 mi^2. The watercourse is composed of two major segments, the north and south branch. The north branch, located in Camden County, has a drainage area of approximately 21 mi^2 and flows for about 9.1 miles. The south branch (Camden-Gloucester County border) has a drainage area of approximately 25 mi^2 and flows for about 10 miles. The main stem has a drainage area of approximately 17 mi^2 and flows for about 7.5 miles before its confluence with the Delaware River. The channel is tidal for approximately 6.5 miles.

Land use in the basin is predominantly suburban and approximately 50% of the total land area is developed. Although agricultural/forested areas exist along mid-segments and in some of the southern headwater regions, suburban development is competing for this land and becoming more prevalent.

b. Water Quality: EPA STORET Water Quality Data and

Big Timber Creek

208 Water Quality Studies (DVRPC, 1977) indicate severe water quality problems in the basin. Water quality violations (as established by the 208 Regional Water Quality Management Program) include DO, TP, NH_3-N, pH and fecal coliform. Overall, these violations stem from three industrial, three non-municipal and 13 municipal point source discharges. In addition, six landfills, two industrial storage tanks, two feedlots, septic tanks and one lagoon are located within the basin that may be considered site-specific, non-point source discharges. Further, the associated runoff from suburban and agricultural areas greatly increase concentrations of organic, sediment and sediment-related pollutants.

Organisms tolerant of organic pollution, including tubificid worms, hydropsychid larvae, chironomid larvae and leeches were the most common macroinvertebrates species sampled in the basin (Craighead, 1971).

c. Lotic: The headwater regions are composed of several perennial and intermittent tributaries. Overall, the watercourse flows toward the Delaware River through remnant agricultural/forested areas and

expanding suburban developments. Above the tidal segment the channel averages two feet or less in depth and is approximately ten feet wide. In the tidal segment mean depth averages four feet and mean width 100 to 800 feet. In undisturbed reaches substrate consists mostly of sand and gravel. Discharge at the mouth of the watercourse was recorded at 61 cfs, of which 21 cfs was from the north branch and 26 cfs from the south branch (Hydroscience, 1975). Wetland areas are characteristic along the floodplain and contain vegetational communities of wild-rice, common reed, arrowhead, smartweed, cattail, marsh hibiscus, arrow-arum, spatterdock and pickerelweed (Academy of Natural Sciences of Philadelphia, 1973). The tidal segment is classified as TW-2 waters while the basin above the tidal segment is classified as FW-2 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Fifteen major impoundments are contained in the basin. Nine are located along the north branch, four along the south branch, one on the main stem and one on Almonesson Creek, a tributary to the main stem. Mean lake depth is about five feet. Available data (DVRPC, 1977) indicate eutrophic conditions in these waterbodies. Siltation

and excessive aquatic plant growth are common. Aquatic vegetation consists of bladderwort, water lily, cattail and arrowhead. Phytoplankton levels may be exceptionally high during the summer.

Trout stocking in the basin is limited to Grenlock Lake, Rowand Lake and Big Lebanon Run (i.e., adult rainbow and brown trout). Rowand Lake is also stocked with largemouth bass. Previous State stocking in the basin consisted of trout in Almonesson Lake and largemouth bass/sunfish in several other impoundments.

2. Terrestrial

Big Timber Creek flows through a highly populated region. The basin lies within the Inner Coastal Plain with an elevation generally under 100 feet. Soils consist of unconsolidated sand, gravel, clay and marl.

The impact of human activity adjacent to most of the watercourse is obvious with industrial, commercial and residential development. Much of the remnant agricultural/forested acreage along mid-segments and in some of the southern headwater regions is now in or is proposed for development. Furthermore, existing natural riparian habitat has been impacted by human activity, leaving minimal buffer zones for wildlife or the protection of

aquatic ecosystems.

Vegetational community structure consists of a mixed-oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, sassafras, spice-bush and various herbaceous communities. A more detailed vegetation list is given in Appendix A.

B. Species Composition

1. Fishes

Big Timber Creek supports several species of fish, although anadromous clupeid spawning of shad and herring no longer exists (Zich, 1977). Overall, species composition is diverse and includes resident, anadromous and introduced species (e.g., carp, goldfish, bluegill sunfish, black crappie, largemouth bass). Recent sampling data are listed in Appendix B, Table 11a-11c. American eel is the most common species supported by Big Timber Creek.

2. Wildlife

Wetland areas along the watercourse support a wide variety of aquatic and terrestrial organisms. The main stem contains wetland habitat necessary for migratory

waterfowl, wading birds and raptorial species. This area also provides desirable habitat for muskrats, mice and Norway rats. In developed areas the pressure of residential, commercial and industrial activities has resulted in the extirpation of numerous species. However, this situation creates an environment for urban-type wildlife species (e.g., gray squirrel, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Big Timber Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse and surface

habitat supporting anadromous fish. These areas should be protected from further degradation.

Figure 12a. Headwater tributary north of Deptford.

Figure 12b. Meander segment south of [illegible].

Woodbury Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Woodbury Creek forms a small basin located in Gloucester County and has a drainage area of approximately 12.6 mi^2. The watercourse flows for approximately 4.5 miles, originating as intermittent streams and flowing through several impoundments/mud flats before its confluence with the Delaware River. The basin is tidal for about 3.5 miles, including the 1.5 mile long Hessian Run and 2.0 mile long Matthews Branch tributaries. The floodplain area along the tidal segment is characteristic of wetlands and mud flats. Land use in the basin is primarily composed of heavy urban/suburban development.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe TP, NH_3-N and fecal coliform problems. Data also indicate moderate DO problems, but this may be influenced by the dam on Stewart Lake. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem primarily from three point source discharges. In addition, there are site-specific non-point sources dis-

charging from two landfills, two feedlots and one industrial lagoon. Since Woodbury Creek drains urbanized areas, the associated runoff greatly increases concentrations of organic, nutrient, sediment and sediment related pollutants. Organisms tolerant of organic pollution, including tubificid worms and leeches, were the most common macroinvertebrate species sampled in the basin (Academy of Natural Sciences of Philadelphia, 1973; Good, et.al., 1975). Additional benthic fauna investigations (Craighead, 1971) show high concentrations of chironomid larvae.

c. Lotic: Woodbury Creek originates with a few intermittent tributaries and Glen Lake. Downstream, the adjacent floodplain is composed of wetland areas and mud flats. The floodplain along the tidal segment spans a half mile in places. Wetland areas contain vegetational communities of wildrice, spatterdock, cattail, arrow-arum and common reed. Wildrice is reported to cover almost 70% of the marsh areas (Good, et. al., 1973). Mean depth averages approximately four feet in the tidal segment and about two feet in other portions of the basin. Substrate consists mostly of sand. Sedimentation is especially

severe near recent developments and where protective riparian vegetation has been removed. The tidal segment is classified as TW-2 waters while the basin above the tidal segment is classified as FW-3 waters by the New Jersey Department of Environmental Protection.

d. Lentic: The major impoundments in the basin consist of Stewart Lake and Glen Lake. Mean lake depth is approximately five feet. Siltation and aquatic plants are common. Aquatic vegetation consists of pondweed, elodea, cattail, bladderwort, water lily, arrowhead, arrow-arum and pickerelweed. Phytoplankton levels may be exceptionally high during the summer.

Stocking programs have been terminated in the basin. Previous State stocking consisted of largemouth bass in some of the impoundments.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel and clay.

Woodbury Creek

The wetland areas along the tidal segment are biologically productive and support a variety of flora and fauna. However, except for small agricultural/ forested areas in the headwaters, the remainder of the basin is developed. The existing vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebuch and various herbaceous communities. A more detailed vegetational list is presented in Appendix A.

B. Species Composition

1. Fishes

Woodbury Creek supports several species of fish. However, water quality problems in the tidal segment restrict anadromous runs and fish kills are common. Spawning runs of American shad no longer exist (Zich, 1977). Further, bacterial and/or fungal fish infections are reported (Good, et.al., 1975). A recent field trip to the study area disclosed a gizzard shad kill. Recent sampling data are given in Appendix B, Table 12. The brown bullhead listed on Table 11 had a large cancerous growth on the mouth parts. Additional

species collected (Hastings, 1974) include American eel, blueback herring, alewife, eastern mudminnow, goldfish, carp, silvery minnow, golden shiner, spottail shiner, bluntnose minnow, banded killifish, mummichog, white perch and black crappie. The mummichog is the most abundant species in Woodbury Creek.

2. Wildlife

Portions of the tidal segment contain habitat that supports a wide variety of aquatic and terrestrial organisms. The wetland vegetation provides food and cover for many wildlife species. Wading birds are common during the spring and fall migration periods. This area also provides desirable habitat for muskrats, mice and Norway rats. However, in developed areas the pressure of residential, commercial and industrial activities has resulted in the extirpation of numerous species. Further, this situation creates an environment for urban-type wildlife species (gray spuirrel, Norway rat, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of

flora and fauna are not known to occur in the Woodbury Creek basin. There is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland areas in the tidal segment. These areas, including any natural riparian habitat and nursery habitat supporting anadromous fish should be protected from further degradation.

Mantua

Figure 13a. Headwater tributary east of Mantua Grove.

Figure 13b. Mainstem segment east of Paulsboro.

Mantua Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: The Mantua Creek watershed is located in Gloucester County and has a drainage area of approximately 60 mi^2. The watercourse flows for approximately 15 miles before its confluence with the Delaware River. Major tributaries include the five mile long Edwards Run, the 7.5 mile long Chestnut Branch and the three mile long Monongahela Branch. The floodplain area along the tidal segment is characteristic of wetlands and mud flats. The basin is tidal for about 7.5 miles.

Land use in the basin is mixed. Heavy concentrations or urban/suburban developments prevail with agricultural/forested areas near the northern headwaters and along Edwards Run which flows out of the southern headwater region. Suburban development, however, is competing for this land and becoming more prevalent.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate severe TP and fecal coliform problems. Data also indicate violations of DO, pH and NH_3-N in some

segments of the watercourse. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem primarily from 10 point source discharges located in the basin. In addition, there are site-specific non-point sources discharging from 11 landfills, eight feedlots, eight lagoons and septic tank systems. Further, the associated runoff from suburban and agricultural areas greatly increases concentrations of organic, sediment and sediment-related pollutants. Organisms tolerant of organic pollution, including hydropsychid larvae, chironomid larvae and tubificid worms were the most common macroinvertebrate species sampled in the basin (Craighead, 1971).

c. Lotic: Mantua Creek originates with several intermittent tributaries as it flows out of its headwater regions. Overall, the watercourse flows toward the Delaware River through remnant agricultural/forested areas and expanding suburban developments. Above the tidal segment the channel averages one foot or less in depth and is approximately six feet wide. Substrate consists mostly of sand. In the tidal segment mean depth averages three feet and mean width may span a half mile

when the mud flats are inundated. The tidal segment is classified as TW-2 waters while the basin above the tidal segment is classified as FW-3 waters by the New Jersey Department of Environmental protection.

d. Lentic: Several lakes and minor impoundments are contained in the basin. Major lakes include Lake Oberst, Kandle Lake, Cedar Lake, Kressly Lake, Alcyon Lake, Bethel Lake and Monongahela Brook Lake. Mean lake depth is about five feet. Alcyon Lake is the largest impoundment, containing approximately 25 acres of water surface area. Available data (DVRPC, 1977) indicate heavy phosphorous loading and eutrophic conditions in these waterbodies. Siltation and excessive aquatic plants are common. Aquatic vegetation consists of elodea, cattail, pondweed, arrow-arum, pickerelweed, watermilfoil and arrowhead. Phytoplankton levels may be exceptionally high during the summer.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. The elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel and clay.

Mantua Creek

Adjacent wetland areas along the tidal segment are biologically productive and support a variety of flora and fauna. The impact of human activity along the main stem, north branch and southern headwater region is obvious with industrial, commercial and residential development. Much of the remnant agricultural/forested acreage contained in the basin is now in or is proposed for development. Furthermore, existing natural riparian habitat has been impacted by human activity, leaving minimal buffer zones for wildlife or the protection of aquatic ecosystems.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse communities are also found on abandoned agricultural fields during various successional stages. A more detailed vegetational list is presented in Appendix A.

B. Species Composition

1. Fishes

Although anadromous clupeid spawning runs of blueback

herring and alewife have been confirmed (Zich, 1977), they may be restricted due to water quality problems. Current sampling data are not impressive, being composed primarily of rough fish. Killifish is the most common species supported by Mantua Creek. Recent sampling data are presented in Appendix B, Table 13. In addition to this list, many of the lakes in the basin support carp, goldfish, creek chubsucker, brown bullhead, largemouth bass, golden shiner, and catfish. This is the only basin in the study area that bowfin have been reported.

2. Wildlife

Portions of the tidal segment contain habitat that supports a wide variety of aquatic and terrestrial organisms. The wetland vegetation provides food and cover for many wildlife species, including wading birds, shorebirds, raptorial birds, migratory waterfowl, muskrats, mice and Norway rats. Marshlands east of the Mantua Creek channel contain valuable migratory waterfowl habitat.

In developed portions of the basin, the pressure of residential, commercial and industrial activities has resulted in the extirpation of numerous species. However, this situation creates an environment for urban-type

wildlife species (e.g., gray squirrel, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Mantua Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, *pers. comm.*).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

Figure 14a. Headwater tributary west of Tomlin.

Figure 14b. Mainstem segment north of Repaupo Station.

Repaupo Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: The Repaupo Creek watershed is located in Gloucester County and has a drainage area of approximately 35 mi^2. The watercourse flows for approximately 12 miles before its confluence with the Delaware River. Major tributaries include the 4.0 mile long Nehonsey Brook, 6.5 mile long Still Run and the 6.5 mile long Pargey Creek. Wetland habitat is characteristic along the watercourse. The basin is tidal for about 5.5 miles.

Land use in the basin is mixed. Although agricultural/forested areas comprise a substantial portion of the basin, suburban development is competing for this land and becoming more prevalent.

b. Water Quality: Although 208 Water Quality Data (DVRPC, 1977) include Repaupo Creek in the Mantua Creek drainage basin, no data are given that specifically relate to this watercourse. However, there are six known point source discharges, including three industrial, two municipal and one non-municipal discharge located within the basin. Further, there are four landfills and three lagoons

which can be considered site-specific non-point sources of pollution. Sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream. Although no current water quality data are available, it is reasonable to expect that DO, pH, TP, NH_3-N and fecal coliform problems occur.

c. Lotic: The watercourse flows toward the Delaware River through agricultural/forested areas and expanding suburban developments. Above the tidal segment the channel averages one foot in depth and is approximately six feet wide. Substrate conditions have been altered as the stream flows through agricultural areas. In undisturbed reaches, substrate consists mostly of sand. In the tidal segment, mean depth averages about four feet and mean width ranges from 100 to 200 feet. The tidal segment is classified as TW-2 waters, while the remainder of the basin is classified as FW-3 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Only a few shallow impoundments, including Warrington Millpond, Greenwich Lake and Logan Pond,

are contained in the basin. Mean lake depth is approximately four feet. All lakes in the basin are potentially eutrophic and are characterized by siltation and aquatic plant growth. Phytoplankton levels may be exceptionally high during the summer.

Stocking in the basin is limited to Greenwich Lake (i.e., adult rainbow trout). Trout stocking is also proposed for Logan pond. Previous State stocking in other impoundments consisted of large-mouth bass, channel catfish and trout.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. The elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel and clay.

Wetland habitat is characteristic within the flood-plain. Along the tidal segment a considerable portion of wetland habitat has been ditched for mosquito control since the 1930's.

In existing forested areas, vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar,

red maple and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse communities are also found on abandoned agricultural fields during various successional stages. A more detailed vegetational list is presented in Appendix A.

B. Species Composition

1. Fishes

Although no recent sampling data are available, nursery habitat in Repaupo Creek may be utilized by anadromous fish. However, actual spawning runs of American shad, blueback herring and alewife no longer exist (Zich, 1977). Species such as carp, goldfish, brown bullhead, gizzard shad, white perch, pumpkinseed sunfish, golden shiner, banded killifish, black crappie, mummichog, redfin pickerel and American eel probably occur. Warmouth, an introduced and uncommon species in New Jersey, occurs in Greenwich Lake (Frank Bolton, pers. comm.). In Cedar Swamp, located adjacent to the tidal segment, the U.S. Fish and Wildlife Service (1977) reported nursery habitat containing juvenile American shad, alewife and blueback herring.

2. Wildlife

Portions of the tidal segment contain habitat that

supports a wide variety of aquatic and terrestrial organisms. The wetland vegetation provides desirable habitat for muskrats, mice, Norway rats, wading birds, shorebirds, raptorial species and migratory waterfowl. However, the pressure of residential, commercial and industrial activities have resulted in the extirpation of numerous species. Furthermore, this situation creates an environment for urban-type wildlife species (e.g., gray squirrel, Norway rat, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). The remaining agricultural/forested areas provide desirable wildlife habitat in the basin. These lands provide "edge" for wildlife to feed, breed and for territorial requirements. A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally-designated threatened or endangered species of flora and fauna are not known to occur in the Repaupo Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally-designated endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

Repaupo Creek

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

Raccoon Creek

Figure 15a. Headwater tributary south of Mullica Hill.

Figure 15b. Mainstem segment west of Bridgeport.

Raccoon Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Raccoon Creek is located in Gloucester County and has a drainage area of approximately 47 mi^2. In 1970 this area supported a population of approximately 7,000 people. The main stem of Raccoon Creek flows for about 16 miles before draining into the Delaware River. The south branch contains the southern headwater region and flows for about six miles before its confluence with the main stem. The watercourse is tidal for about 10 miles, where the Swedesboro Dam creates a barrier.

Land use in the basin is predominantly agricultural. Suburban development, however, is competing for this land and becoming more prevalent. Large housing developments are proposed along the main stem in Logan and Woolwich townships. The major urban/suburban area is located along the main stem at Swedesboro.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate DO, TP, NH_3-N, pH and fecal coliform problems. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem

rrimarily from four point source discharges. In addition, there are site-specific non-point sources discharging from two landfills, three lagoons, two feedlots and septic tank systems. Total phosphorous violations are due to the extensive agricultural activity in the area. Sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream.

Organisms tolerant of organic pollution, including hydropsychid larvae and chironomid larvae were the most common macroinvertebrate species sampled in the basin (Craighead, 1971).

c. Lotic: The headwater regions are composed of several intermittent and perennial tributaries that flow through agricultural/forested areas. Downstream, agricultural practices, including the removal of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through agricultural areas. In undisturbed reaches, the channel averages one foot or less in depth and is approximately six feet wide. In the tidal segment

mean depth is about four feet and mean width ranges from 100 to 200 feet. The substrate here is composed of a high clay content. The tidal segment is classified as TW-2 waters, while the remainder of the basin is classified as FW-3 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Seven major impoundments are contained in the basin. These include Gilman Lake, Ewan Lake, Omary Lake, Mullica Hill Pond, Clems Run Pond, Lake Basgalore and Swedesboro Lake. Mean lake depth is about five feet. Available data (DVRPC, 1977) indicate heavy phosphorous loading and eutrophic conditions in these waterbodies. Siltation and excessive aquatic plant growth are common. Aquatic vegetation consists of bladderwort, waterlilies, duckweed, watermilfoil and cattail. Phytoplankton levels may be exceptionally high during the summer.

Trout are stocked in Mullica Hill Lake, Swedesboro Lake and in Raccoon Creek, between Ewan and Swedesboro (i.e., adult rainbow and brown trout). Previous State stocking in the basin consisted of channel catfish in Swedesboro Lake.

Raccoon Creek

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel and clay.

Agriculture is the major land use in the basin. Remaining acreage consists of wetlands, abandoned fields, woodlands and scattered developments.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse plant communities are found on abandoned fields during various successional stages. Common pioneer species include grasses and sedges, goldenrod, blackberry, eastern redcedar, gray birch, sumac, poison ivy, red maple, sassafras and black cherry. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

The fish populations of Raccoon Creek are composed pri-

marily of rough fish. Overall, species composition is diverse and includes resident, anadromous and introduced species (e.g., carp, goldfish, bluegill sunfish, largemouth bass). Although spawning runs of American shad no longer exist, runs of blueback herring and alewife have been confirmed (Zich, 1977). Recent sampling data are presented in Appendix B, Table 15a-15b. Additional species collected in the south branch (Hastings, 1977) include American brook lamprey, spottail shiner, swallowtail shiner and tessellated darter.

2. Wildlife

Dredge spoil deposits and dense communities of common reed west of Highway 130 decrease the potential of a viable wildlife population. This area supports rodent populations and associated raptors. Other portions of the basin support a wide variety of aquatic and terrestrial organisms. Marsh areas along the tidal segment support small mammals, wading birds, shorebirds, raptors and migratory waterfowl. Continued development will result in the extirpation of numerous species. Developed areas will create an environment for urban-type wildlife species (e.g., gray squirrel, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed

list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Raccoon Creek basin. However, there is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren, Zich, pers. comm.).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, undisturbed terrestrial habitat adjacent to abandoned fields, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

Maple Swamp

Figure 16a. Maintain sedge north of Logan.

Maple Swamp

A. Habitat Description

1. Aquatic

a. Description of Basin: Maple Swamp forms a small basin located in Gloucester County and has a drainage area of approximately 4.5 mi^2. The basin is bounded to the north by Raccoon Creek and to the south by Oldmans Creek. Flat topography, marsh areas and mosquito ditching make it difficult to delineate the actual topographic divide. The watercourse flows for approximately 2.5 miles before its confluence with the Delaware River. The entire basin is tidal, classified as TW-2 waters by the New Jersey Department of Environmental Protection. Land use in the basin is primarily dredge spoil deposited along the main stem, Birch Creek.

b. Water Quality: Although 208 Water Quality Data (DVRPC, 1977) include Maple Swamp in the Raccoon-Oldmans drainage basin, no data are given that specifically relate to this watercourse. However, a lagoon and landfill are located within the basin which can be considered site-specific non-point sources of pollution. In addition, tidal action may result in DO problems. It is reasonable to

expect that DO, pH, TP, NH_3-N and fecal coliform problems occur. No data were reviewed pertaining to the dredge spoil material.

c. Lotic: The basin originates as marsh and manipulated marsh areas containing mosquito ditching. Further downstream, the watercourse flows through a shallow impoundment that drains through Birch Creek to the Delaware River. Mean width of Birch Creek is approximately 15 feet and mean depth about two feet. The substrate is characterized by a high clay content. Riparian vegetation consists predominantly of common reed with few woody plants.

d. Lentic: One major shallow impoundment is contained in the basin. Mean depth is approximately two feet. Dense communities of common reed prevail. In remnant undisturbed areas, aquatic vegetation consists of spatterdock, arrow-arum and wildrice.

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevation is generally under 50 feet. Topography in the basin is nearly level except where dredge spoil has been deposited. Soil types consist of a high clay content.

Maple Swamp

The shoreline along the Delaware River and most of Birch Creek is diked and filled with dredge spoil. Only isolated developments occur within the basin. Common reed is the most common plant species, illustrating the poor quality of the existing habitat.

B. Species Composition

1. Fishes

Degradation of the aquatic habitat has limited the fishery resource in Maple Swamp. Although no recent sampling data exist, fish populations are composed primarily of rough fish. The mummichog is the most abundant species reported in Maple Swamp (Academy of Natural Sciences of Philadelphia, 1973).

2. Wildlife

The dense communities of common reed provide little habitat for a wide variety of aquatic and terrestrial organisms. This habitat does, however, support muskrats. Common reed also provides cover for other small rodents, the prey species of many raptors. A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally-designated threatened or endangered species of

flora and fauna are not known to occur in the basin.

D. Important and Unique Habitat

Maple Swamp provides good habitat for rodent populations and associated raptors.

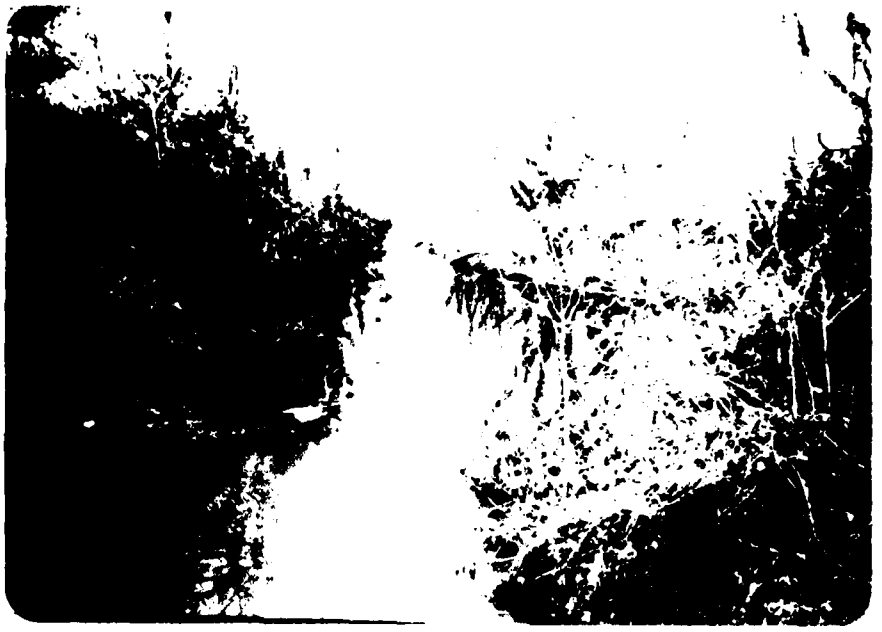

Figure 17a. Headwater tributary west of Harrisonville.

Figure 17b. Mainstem segment north of Auburn.

Oldmans Creek

A. Habitat Description

1. Aquatic

a. Description of Basin: Oldmans Creek is the southernmost basin that drains into the Delaware River. The watercourse delineates the boundary between Gloucester and Salem Counties, with 21.5 mi^2 of the drainage being located in the study area. In 1970, this area supported a population of approximately 1,200 people. The main stem of Oldmans Creek flows for about 24.5 miles before draining into the Delaware River. The watercourse is tidal for about 12 miles.

Land use is predominantly agriculture, consistent with the Raccoon Creek basin located to the north. Approximately 60% of the total land area is farmed. As in the Raccoon Creek basin, suburban development is competing for the land and is becoming more prevalent.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate DO, TP, NH_3-N, pH and fecal coliform problems. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem primarily from agricultural land use. In addition, the

basin contains site-specific non-point sources of pollution, including one landfill, five feedlots and septic tank systems. Further, sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream.

Organisms tolerant of organic pollution, including chironomid larvae, were the most common macro-invertebrate species sampled in the basin (Craighead, 1971).

c. Lotic: The watercourse flows primarily through agricultural/forested areas and scattered developments before its confluence with the Delaware River. Agricultural practices, including the removal of protective riparian vegetation, have degraded segments of the watercourse by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through these areas. In undisturbed reaches, substrate consists mostly of sand and gravel. In headwater reaches, the channel averages one foot or less in depth and is approximately six feet wide. In the tidal segment mean depth is about five feet and mean

width ranges from 100 to 250 feet. The floodplain along the tidal segment is extensive and characteristic of wetland areas. The substrate here is composed of a high clay content. The tidal segment is classified as TW-1 waters and the remainder of the basin is classified as FW-3 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Three major lakes are contained within the basin. These include Algonkin Lake, Harrisonville Lake and Porches Mill. Mean lake depth is approximately three feet. Dams are located on Algonkin Lake and Harrisonville Lake. Available data (DVRPC, 1977) indicate heavy phosphorous loadings and eutrophic conditions in these waterbodies. Overall, associated runoff from agricultural areas is accelerating the eutrophic process in these impoundments. Siltation and excessive aquatic plant growth are common. Aquatic plants consist of bladderwort, waterlilies, duckweed, watermilfoil and cattail. Phytoplankton levels may be exceptionally high during the summer.

Rainbow trout are stocked in Harrisonville Lake. Previous State stocking consisted of trout, channel catfish and largemouth bass in Harrisonville Lake.

Oldmans Creek

2. Terrestrial

The basin lies within the Inner Coastal Plain of New Jersey. Elevation is generally under 100 feet. Topography in the basin is nearly level to gently sloping. Soil types consist of unconsolidated sand, gravel and clay.

Adjacent wetland areas along the tidal segment are biologically productive and support a variety of flora and fauna. However, a considerable amount of this habitat has been eliminated with dredge spoil deposits. Upstream segments consist predominantly of agricultural/forested areas, including abandoned farmland. This abandoned land is steadily being committed to suburban development.

Vegetational community structure consists primarily of a mixed oak forest type. Associates of this forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Black birch is common along the watercourse. Understory vegetation may consist of dogwood, ironwood, sassafras, spicebush and various herbaceous communities. Diverse plant communities are found on abandoned fields during various successional stages. Common pioneer species include grasses and sedges, goldenrod, black-

berry, eastern redcedar, gray birch, sumac, poison ivy, red maple, sassafras and black cherry. A more detailed vegetation list is presented in Appendix A.

B. Species Composition

1. Fishes

The fish populations of Oldmans Creek are composed primarily of rough fish. Overall, species composition includes resident, anadromous and introduced species (e.g., carp, bluegill sunfish, black crappie, largemouth bass). Although spawning runs of American shad no longer exist, runs of alewife have been confirmed (Zich, 1977). Recent sampling data are presented in Appendix B, Table 17. American eel is the most common species in the basin. Additional species collected in Oldmans Creek (Hastings, 1977) include creek chubsucker, common shiner, swallowtail shiner, banded killifish, redbreast sunfish and black crappie.

2. Wildlife

Dredge spoil deposits and dense communities of common reed west of Highway 130 decrease the potential of a viable wildlife population. This area, however, supports small rodent populations and associated raptors. Marsh areas along the tidal segment support

small mammals, wading birds, shorebirds, raptors and migratory waterfowl. In other portions of the basin, agricultural land, abandoned fields, natural riparian habitat, marshes and woodlands support a wide variety of aquatic and terrestrial organisms.

Continued development will result in the extirpation of numerous species. Developed areas will create an environment for urban-type wildlife species (e.g., gray squirrel, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the Oldmans Creek basin. However, there is the possibility that the short-nose sturgeon, a Federally endangered species, may occur near the confluence with the Delaware River (Barren; Zich, pers. comm.).

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, undisturbed terrestrial

habitat adjacent to abandoned fields, undisturbed sections of the watercourse and nursery habitat supporting anadromous fish. These areas should be protected from further degradation.

Figure [illegible]. Headwater tributary in Pries Mill.

Maurice River

A. Habitat Description

1. Aquatic

a. Description of Basin: The Maurice drainage is a large basin originating in Gloucester and Salem Counties. The watercourse flows southeast through Cumberland County before its confluence with Delaware Bay. Overall, the basin drains approximately 388 mi^2, although the study area contains only a 78 mi^2 portion of the headwaters. In 1970, the population in this portion of the basin was approximately 18,000 people concentrated at Fries Mill, Malaga, Franklinville, Clayton and around Glassboro.

Land use is primarily composed of forested (58%) and agricultural (30%) areas. Suburban development, however, is competing for this land and is becoming more prevalent. Approximately 12% of the land is currently developed.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate TP, pH, and fecal coliform problems. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem primarily

from septic tanks and agricultural activity. In addition, this portion of the basin contains two industrial discharges, four landfills, three lagoons and one spray irrigation site.

c. Lotic: The headwater tributaries located in this portion of the basin flow primarily through agricultural/forested areas and expanding developments. The major tributaries include the 10.5 mile long Scotland Run, the nine mile long Still Run and the nine mile long Little Ease Run. Wetland habitat is characteristic along these reaches, minimizing bank erosion and sedimentation. These streams average two feet or less in depth and are approximately 12 feet wide. Substrate consists mostly of sand and gravel with overlying detritus. In the study area the watercourse is classified as FW-3 waters, excluding the Glassboro Wildlife Management Area reaches which are classified as FW-1 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Seven major impoundments are contained within this portion of the basin. These include Wilson Lake, Malaga Lake, a recently diked impoundment on Scotland Run, Franklinville Lake, Silver Lake, Idle Acres Lake and Iona Lake. Mean lake

depth is about four feet and all are naturally acidic. Available data (DVRPC, 1977) indicate heavy phosphorous loading and eutrophic conditions in these waterbodies. Aquatic plant growth is common and consists of bladderwort, spatterdock, waterlily, arrowhead and cattail. Phytoplankton levels may be exceptionally high during the summer.

State stocking is limited to Iona Lake (i.e., adult brook and brown trout). Previous stocking consisted of largemouth bass in Malaga Lake and largemouth bass and channel catfish in Franklinville Lake.

2. Terrestrial

The basin lies within the Outer Coastal Plain of New Jersey. Elevation is generally under 150 feet. Topography is generally flat with some scattered hills. Soil types consist of sand, clay and gravel.

Agriculture is the major land use in this portion of the basin. This acreage, however, is steadily being committed to suburban development. Remaining areas consist of wetlands, Atlantic white-cedar swamps, abandoned fields, and woodlands.

Maurice River

Vegetational community structure consists of a mixed oak-pine forest type. This is basically a transition zone into the Pine Barrens as pine becomes more prevalent in the stand. Associates of this forest type vary with site but normally include pitch pine, shortleaf pine, black cherry, sassafras, pignut hickory, blackjack oak, post oak, black and scrub oaks on upland sites and red maple, blackgum, sweetbay, sassafras, sweetgum and Atlantic white-cedar on moist sites. Virginia pine is found along the edges of the pitch pine stands. Understory vegetation and herbaceous communities vary with each of these different site conditons. A more detailed vegetation list is given in Appendix A.

B. Species Composition

1. Fishes

Fish populations supported by these headwater reaches are composed of species tolerant of acid waters (e.g., mud sunfish, blackbanded sunfish, banded sunfish, swamp darter, chain pickerel).

Although collected downstream from the study area, recent sampling data of the Maurice River are presented in Appendix B, Table 18. Species collected (Hastings,

1977) from Still Run below Iona Lake include eastern mudminnow, tadpole madtom, creek chubsucker, pirate perch, bluespotted sunfish, pumpkinseed sunfish, bluegill sunfish, swamp darter and tessellated darter. Anadromous runs of blueback herring and alewife have been confirmed (Zich, 1977) in the Maurice River up to the Union Lake Dam. This barrier prevents further upstream migration into the study area.

2. Wildlife

This portion of the basin contains several habitat types, including marshy lowlands, Atlantic white-cedar swamps, abandoned fields and woodlands, supporting a wide variety of aquatic and terrestrial organisms. A recent inventory of Franklin Township (Franklin Township Environmental Commission, 1975) listed 22 common mammals, 12 snakes and 20 turtles, frogs and amphibian species. In addition, 140 species of avifauna were reported, including the osprey and Cooper's hawk. Continued development will result in the extirpation of numerous species. Developed areas will create an environment for urban-type wildlife species (e.g., gray squirrel, herring gull, common crow, robin, starling, house sparrow, dark-eyed junco, snapping turtle). A more detailed list of wildlife species that may occur in this portion of the basin is given in Appendix C.

Maurice River

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the headwaters of the Maurice basin. However, the osprey, Cooper's hawk, eastern tiger salamander and the Pine Barrens treefrog, which are reported to occur, are classified by the State of New Jersey as endangered. The Pine Barrens treefrog has been nominated for the Federal Endangered Species List. Further, Knieskern's beaked-rush has also been nominated for the Federal Endangered Species List and is reported to occur in the Pine Barrens.

D. Important and Unique Habitat

The most ecologically important areas within this portion of the basin consist of undisturbed wetland habitat including Atlantic white-cedar swamps, undisturbed terrestrial habitat adjacent to abandoned fields, undisturbed sections of the watercourse, natural riparian habitat, the Pine Barrens and the Pine Barrens aquifer. The Pine Barrens and associated habitats are considered unique. These areas should be protected from further degradation.

Although downstream from the study area in Salem and Cumberland Counties, a segment of the Maurice has been suggested for study and consideration as a wild and scenic river under the Wild and Scenic Rivers Act (P.L. 90-542).

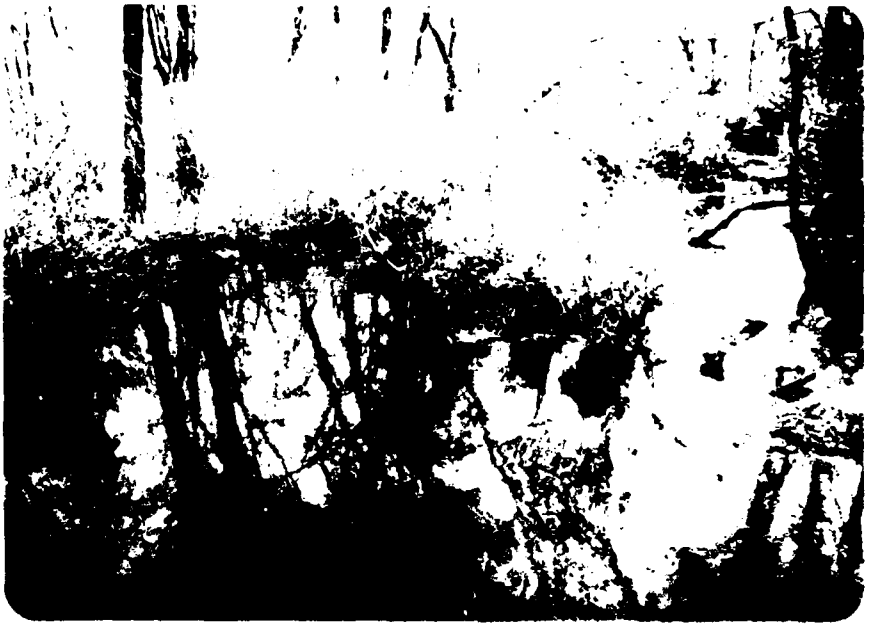

Figure 19a. Headwater tributary northeast of Sicklerville.

Great Egg Harbor River

A. Habitat Description

1. Aquatic

a. Description of Basin: The Great Egg Harbor drainage is a large basin originating in Camden County. The watercourse flows through Gloucester and Atlantic Counties before its confluence with the Atlantic Ocean. Overall, the basin drains approximately 338 mi^2. However, the study area only contains a 96 mi^2 portion of the headwaters. In 1970, the population in this portion of the basin was about 59,300 people.

Land use is primarily composed of oak-pine forests (67%) and agricultural (22%) areas. Suburban development, however, is competing for this land and is becoming more prevalent. Approximately 11% of the land is currently developed, concentrated on the western side of the basin and in the northern areas around Berlin.

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate DO, pH, NH_3-N, TP and fecal coliform problems. Violations of water quality (as established by the 208 Regional Water Quality Management Program) stem from point source and site-specific non-point

source discharges located in the basin. Point sources include two municipal and one non-municipal discharge. Site-specific non-point sources include five landfills, six lagoons, one feedlot, two spray irrigation sites and septic tank systems. Runoff from agricultural and urban areas creates a further problem by accelerating the organic, nutrient, sediment and sediment related pollutant load on the watercourse. Low pH readings are characteristic of the Pine Barrens and controlled by the naturally acidic soils.

c. Lotic: The headwater tributaries located in this portion of the basin originate in developed areas. Overall, the watercourse flows through agricultural/forested areas and expanding suburban developments. The major tributaries in the study area include the 12.5 mile long main stem, the four mile long Four-mile Branch, the five mile long Squankum Branch and the three mile long Hospitality Branch. These slow-flowing streams average two feet or less in depth and are approximately five feet wide.

Riparian habitat receives periodic inundation, and swamp areas are characteristic along many of these headwater reaches. Substrate consists mostly of

sand and gravel with overlying detritus. In this portion of the basin the watercourse is classified as FW-3 waters by the New Jersey Department of Environmental Protection.

d. Lentic: Several lakes and minor impoundments are contained in the basin. Major lakes include New Brooklyn Lake, Timber Lake, Sunset Lake, Victory Lake, Crystal Spring Lake, Diamond Lake, Hospitality Lake, Cains Mill Lake, Cedar Lake and McCarthys Lake. These lakes usually originate from cranberry bogs, gravel pits and diking. Mean lake depth is about four feet and all are naturally acidic. Available data (DVRPC, 1977) indicate phosphorous loading and eutrophic conditions in these waterbodies. Aquatic plant growth is common and consists of bladderwort, spatterdock, waterlily, arrowhead and cattail. Due to natural conditions, some of the impoundments illustrate dystrophic characteristics.

2. Terrestrial

The basin lies within the Outer Coastal Plain of New Jersey. Elevation is generally under 150 feet. Topography of the basin is generally flat and water saturated soils extend one-quarter mile from the stream channels (Hydroscience, 1975). Soil types consist of sand, clay and gravel.

Great Egg Harbor River

The study area is composed of forested areas, including the Pine Barrens, agriculture and scattered development. Isolated cranberry and blueberry culture are common landscape features in the Pine Barrens. A considerable amount of this area is currently proposed for development.

Vegetational community structure consists primarily of a mixed oak-pine forest type. This is basically a transition zone into the Pine Barrens. Pitch pine becomes more prevalent downstream toward Atlantic County. Associates of this forest type vary with site but normally include various concentrations of pitch pine, shortleaf pine, loblolly pine, black cherry, sassafras, pignut hickory, blackjack oak, post oak, black oak and scrub oak on upland sites and red maple, blackgum, sweetgum and Atlantic white-cedar on moist sites. Virginia pine is found along the edges of the pitch pine stands. Understory vegetation and herbaceous communities vary with each of these different site conditions. A more detailed vegetational list is given in Appendix A.

B. Species Composition

1. Fishes

Fish populations supported by these headwater reaches

are composed of species tolerant of acid waters (e.g., mud sunfish, blackbanded sunfish, banded sunfish, swamp darter, chain pickerel). Although collected downstream from the study area, recent sampling data for the Great Egg Harbor River are presented in Appendix B, Table 19. Species collected (Hastings, 1977) in the Fourmile Branch include American eel, eastern mudminnow, tadpole madtom, pirate perch, swamp darter, tessellated darter and blackbanded, bluespotted, banded, pumpkinseed and mud sunfishes. Anadromous clupeid spawning runs do not migrate this far upstream due to the Lake Lenape Dam in Atlantic County.

2. Wildlife

This portion of the basin contains several habitat types, including marshy wetlands, lowland and upland forest and abandoned fields, supporting a wide variety of aquatic and terrestrial organisms. McCormick (1970) listed 23 amphibians, 30 reptiles and 33 mammals expected to occur in the Pine Barrens habitat contained in Camden County. In addition, 261 species of avifauna are estimated to occur, of which 91 species are expected to nest (J. McCormick & Associates, 1974).

Continued development will result in the extirpation of numerous species, similar to the heavily developed

basins in other sections of the study area. A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Federally designated threatened or endangered species of flora and fauna are not known to occur in the headwaters of the Great Egg Harbor River basin. However, the osprey, Cooper's hawk, eastern tiger salamander and the Pine Barrens treefrog (proposed), which have been reported to occur, are classified by the State of New Jersey as endangered. The Pine Barrens treefrog has been nominated for the Federal Endangered Species List. Further, Knieskern's beaked-rush has also been nominated for the Federal Endangered Species List and is reported to occur in the Pine Barrens.

D. Important and Unique Habitat

The most ecologically important areas within this portion of the basin consist of undisturbed wetland habitat including Atlantic white-cedar swamps, undisturbed terrestrial habitat adjacent to abandoned fields, undisturbed sections of the watercourse, natural riparian habitat, the Pine Barrens and the Pine Barrens aquifer.

Great Egg Harbor River

The Pine Barrens and associated habitats are considered unique. These areas should be protected from further degradation. Although outside the study area, a segment of the watercourse in Atlantic County has been suggested by the State of New Jersey for study and consideration as a wild and scenic river under the Wild and Scenic Rivers Act (P.L. 90-542).

Figure 20a. Headwater region in the Wading sub-basin.

Figure 20b. Mainstem segment near Port Republic.

Mullica River

A. Habitat Description

1. Aquatic

a. Description of Basin: The Mullica River is the largest basin in the study area. Overall, the watercourse drains an area of approximately 568 mi^2 within Burlington, Atlantic and Ocean Counties. Approximately 387 mi^2 are located in the study area. In 1970, this area supported a population of approximately 17,300 people.

The watercourse is composed of six major sub-basins, including the lower Mullica, the Wading, the Batsto, the Atsion, the Sleeper and the Nescochague. The lower Mullica (Atlantic-Burlington County border) flows for about 16 miles and has a drainage area covering 191 mi^2. The Wading flows for about 12 miles and has a drainage area covering 145 mi^2. The Batsto flows for about 16 miles and has a drainage area covering 67 mi^2. The Atsion flows for about 13 miles and has a drainage area covering 43 mi^2. The Sleeper flows for about 10 miles and has a drainage area covering 46 mi^2. The Nescochague flows for about 10 miles and has a drainage area covering 76 mi^2. The watercourse is tidal for approximately 26 miles. The lower 13 miles of this

tidal segment is bordered by 21 mi^2 of saltmarsh.

Land use in the basin is primarily composed of forested Pine Barren areas (83%). The remainder of the basin is in agriculture (12%) and development (5%), mostly concentrated in the western headwater regions.

b. Water Quality: Except for tributaries currently receiving wastewater discharge and/or septic system effluent, water quality is generally good. However, EPA STORET Water Quality Data and 208 Water Quality Studies (DVRPC, 1977) indicate TP, DO, and fecal coliform problems in the basin. Violations of water quality standards (as established by the 208 Regional Water Quality Management Program) stem from one industrial discharge, one non-municipal discharge, seven landfills and septic tank systems. Due to the high groundwater levels through the basin, septic system effluent results in a serious water quality problem. Low pH readings are characteristic of the Pine Barrens and controlled by the naturally acidic soils.

Macroinvertebrate species normally found in a healthy aquatic environment are supported in most headwater regions. In upstream reaches species

may include stonefly, dragonfly and caddisfly larvae.

c. Lotic: The Mullica incorporates numerous tributaries as it flows out of its headwater regions. Acreage under State and Federal ownership enable the watercourse to support relatively undisturbed ecosystems. Except for isolated forest products and cranberry and blueberry culture, the tributaries are undisturbed as they flow through pitch pine stands and Atlantic white-cedar swamps. However, in unprotected portions of the basin, particularly the western headwater regions, expanding suburban development is becoming more prevalent.

The Mullica, being a large basin, naturally illustrates considerable variation in bank and channel characteristics as it flows toward the Atlantic Ocean. Headwater reaches average two feet or less in depth and are approximately 10 feet wide. Substrate is mostly sand and gravel. In the tidal segment, mean depth is about 10 feet while mean width ranges from 100 to 800 feet. The tidal segment is classified as TW-1 waters, public park land (e.g., Wharton State Forest, Bass River State Park) is classified as FW-1 waters and the remainder of the

basin is classified as FW-Central Pine Barrens waters by the New Jersey Department of Environmental Protection.

d. Lentic: The basin contains numerous named and unnamed ponds and lakes, most of which originated as cranberry bogs. Some of the major impoundments include Lake Absegami, Browns Mill Lake, Lake Oswego, Atsion Lake, Batsto Lake, Chatsworth Lake and Harrisville Lake. Mean lake depth is about seven feet and all are acidic. Many of these lakes illustrate dystrophic characteristics. Aquatic plant growth is composed primarily of bladderwort, spatterdock and waterlily. Sphagnum moss and water moss are common on all hydric sites in the Pine Barrens.

Bog habitat is characteristic of the Barrens. Many bogs originated from disturbances, including mining of bog ore and wildfire burning deep into the organic soil of a swamp during extreme drought.

Previous State stocking consisted of alewife in Batsto Lake and largemouth bass in some of the other impoundments.

2. Terrestrial

The basin lies within the Outer Coastal Plain of New

Mullica River

Jersey. Elevation is generally under 200 feet. Soil types consist of coarse sands and gravels.

The basin is almost entirely composed of the Pine Barrens and associated habitats. Due to infertile soil conditions, commercial agriculture is not very productive. However, localized agriculture consists of isolated blueberry and cranberry culture. In addition, small forest products industries are present.

Development of the Pine Barrens was relatively slow until the past decade. Recent trends, however, offer lucrative returns in real estate, and unprotected areas are proposed for development. Recent field trips have shown numerous acreage for sale as well as new road systems and housing developments under construction.

Although pitch pine stands are most characteristic of the Barrens, several forest types are recognized (McCormick, 1970). The lowland forests of the Barrens are characterized by Atlantic white-cedar swamps, maple-gum-magnolia associations and pitch pine lowland forests. Some lowland areas have been cultivated and now support extensive commercial cranberry bogs.

The uplands of the region are characterized by a variety of forest types dominated by pitch pine-mixed oak forests. Included in this type are the areas known

as "The Plains" -- pygmy forests of four to six foot trees where the land is burned over on an average of eight year intervals. The vegetation of the Barrens owes its peculiar character, in large part, to fire. Fire is part of the natural phenomenon in the Pines. It is not a question of if the Barrens should burn, but when. The vegetation that has evolved is, at once, highly flammable and yet genetically resistant to fire by rapid re-establishment. Both pitch and shortleaf pine have the ability to produce sprouts after burning.

Of the approximately 800 species, varieties, and forms of plant life found in the Barrens, two species (i.e., sand myrtle and pickering morning glory) are unique to the region. Of equal interest is the inexplicable fact that at least 111 types of southern plants (e.g., turkey beard) reach their northern boundary in the Barrens while 21 types of northern plants such as the unfern-like curly grass fern reach their southern limit.

B. Species Composition

1. Fishes

The Mullica supports several species of fish. Overall, species composition and distribution is diverse be-

tween the tidal segment and the acidic upstream waters, characteristic of low productivity. The tidal segment supports a viable fisheries resource, including alewife, blueback herring, American shad, hickory shad, gizzard shad, bluefish, striped bass and white perch. The lower end of the tidal segment is characterized by extensive saltmarsh habitat.

Throughout most of the fresh-water segments, fish populations are composed of species tolerant of acidic waters. Although State sampling data (Appendix B, Table 20a-20c) are imcomplete for the entire basin, additional species reported (Hastings, 1978) to occur include American eel, redfin pickerel, eastern mudminnow, tadpole madtom, pirate perch, mud sunfish, banded sunfish, swamp darter and tessellated darter. Anadromous runs of blueback herring and alewife have been confirmed (Zich, 1977) up to the Pleasant Mills Dam. Although temperature and pH conditions in the upstream tributaries appear to be suitable for brook trout, they would be severely handicapped by lack of food organisms, predation of the pickerel and the competition from other species. Former attempts to introduce trout have been unsuccessful.

Mullica River

2. Wildlife

The basin contains several habitat types, including saltmarsh, Atlantic white-cedar swamps, bogs and woodlands, supporting a wide variety of aquatic and terrestrial organisms. Although no animal species is restricted entirely to the Barrens, the area contains the northern range limit of numerous southern species and the southern range limit for several northern species.

At least 91 species of butterflies have been found in the region. This is the southern limit of distribution for six of these and the northern limit for five others. In addition, ten species of salamanders, 13 species of frogs and toads, nine species of turtles, three species of lizards and 18 species of snakes are known to occur in the Barrens. Soils composed of loose sands and gravels influence the occurrence of corn, pine and scarlet snakes, species that are well adapted to burrowing.

There are 34 species of mammals supported by the Barrens. Some of the more common species include gray fox, Virginia oppossum, common raccoon, white-tailed deer, muskrats and several species of bats and shrews.

The general uniformity of vegetation limits the physical

features which affect bird distribution in the Barrens. There are approximately 250 species occurring annually. Ruffed grouse, woodcock and bobwhite quail are fairly common and are noted game species. Whip-poor-wills, common nighthawks, great horned owls, rufous-sided towhees, red-eyed vireos and great crested flycatchers are among the more common birds in the Barrens.

Extensive saltmarsh along the tidal segment supports small mammals, wading birds, shorebirds, raptors and migratory waterfowl.

Continued development will result in the extirpation of numerous species. A more detailed list of wildlife species that may occur in the basin is given in Appendix C.

C. Threatened or Endangered Species

Although only occurring as a winter visitor, the bald eagle and, as a transient, the peregrine falcon are the only Federally endangered species known to occur in the basin. In addition, the osprey, Cooper's hawk, eastern tiger salamander and the Pine Barrens treefrog (proposed), which are reported to occur, are classified by the State of New Jersey as endangered. The Pine Barrens treefrog has been nominated for the Federal Endangered Species List. Further,

Mullica River

Knieskern's beaked-rush has also been nominated for the Federal Endangered Species List and is reported to occur in the Pine Barrens.

D. Important and Unique Habitat

The most ecologically important areas within the basin consist of undisturbed wetland habitat, including Atlantic white-cedar swamps and saltmarsh, undisturbed terrestrial habitat adjacent to abandoned fields, undisturbed sections of the watercourse, natural riparian habitat, the Pine Barrens and the Pine Barrens aquifer.

The Pine Barrens and associated habitats are considered unique. These areas should be protected from further degradation.

The Mullica River has been suggested for study and consideration by the State of New Jersey as a wild and scenic river under the Wild and Scenic Rivers Act (P.L. 90-542). Furthermore, two legislative bills have been introduced in Congress concerning the protection of the Pine Barrens. These legislative alternatives include the "New Jersey Pine Barrens National Ecological Reserve Act" (H.R. 6625) and the Forsythe-Hughes proposal (H.R. 9535/9539). The Forsythe-Hughes bill includes the establishment of a 50,000 acre Pinelands National Wildlife Refuge under the jurisdiction of the Fish and Wildlife Service.

Public Use

The 1975 National Survey of Hunting, Fishing and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service, 1977) estimates average annual recreational demands at 24.5 man-days for freshwater fishing, 22.4 man-days for firearm hunting and 10.1 man-days for archery hunting. A day is classified according to the primary activity engaged in on that day. The Survey also estimates that 26.7 percent of all persons over nine years of age engage in non-consumptive forms of wildlife recreation at an average of 32.1 man-days annually. According to the New Jersey Division of Fish, Game and Shellfisheries, license sales are a reasonable estimate of the actual number of county resident hunters and fishermen. These estimates, based on the 1975 National Survey, were used to determine the present recreational demands within the study area (Table 1).

Viewing the three counties collectively shows participants engaged in fishing, hunting, trapping and non-consumptive forms of wildlife recreation totaled 325,346 people. This resulted in almost 10 million recreation-days per year. Furthermore, the State revenue generated from the sale of hunting, fishing and trapping licenses totaled over one-half million dollars.

Burlington County

In 1976, the sale of freshwater fishing licenses numbered 8,447 (Penkala, pers.comm.). According to the 1975 National Survey, this resulted in 206,952 fisherman-days per year. State revenue

Public Use

Table 1

County Public Use Estimates

	Number of Participants	Avg. Annual No. of Days Use	Rec. Days Per Year	Rev. Genrtd. from Lic. Sales
Burlington				
Hunting			271,698	$134,170.00
Firearm	11,072	22.4		
Archery	2,345	10.1		
Fishing	8,447	24.5	206,952	77,229.00
Trapping	280		15,792	2,800.00
Non-Consumptive	94,000	32.1	3,017,400	
Sub-total	116,144		3,511,842	$214,199.00
Camden				
Hunting			241,130	$119,810.00
Firearm	9,766	22.4		
Archery	2,215	10.1		
Fishing	8,542	24.5	209,279	75,390.00
Trapping	58		4,286	580.00
Non-Consumptive	126,000	32.1	4,044,600	
Sub-total	146,581		4,499,295	$195,780.00
Gloucester				
Hunting			188,495	$ 91,760.00
Firearm	7,790	22.4		
Archery	1,386	10.1		
Fishing	5,040	24.5	123,480	43,936.00
Trapping	405		21,655	4,050.00
Non-Consumptive	48,000	32.1	1,540,800	
Sub-total	62,621		1,874,430	$139,746.00
TOTAL	325,346		9,885,567	$549,725.00

Burlington County

generated from the sale of licenses totaled $77,229.

County hunters, as estimated by 1976 license sales, numbered 11,072 firearm hunters and 2,345 archery hunters. According to the 1975 National Survey, this resulted in 271,698 hunter-days per year. State revenue generated from the sale of licenses totaled $134,170.

There are over 105,000 acres of publicly owned open space in the county, of which 1,293 acres are State Fish and Wildlife Management Areas (N.J. SCORP, 1977). Only State Fish and Wildlife Areas are stocked and managed for hunting. Most of the remaining publicly owned open space consists of 102,820 acres of state forests, which provide additional hunting opportunities.

The furbearer resource survey for the county (Penkala, 1977) revealed that revenue generated from the sale of raw furs totaled $354,764. There were 280 trapping licenses issued, and a total of 15,792 man-days of recreation were derived from trapping. State revenue generated from the sale of licenses totaled $2,800. Major furbearers included muskrat, raccoon, red fox, gray fox, mink, skunk, opossum, weasel and beaver.

Non-consumptive forms of outdoor recreation, which include bird watching, wildlife photography and nature hikes, are in great demand. From the county's 1973 population (i.e., 351,908), and according to the 1975 National Survey, it is estimated that there are presently 94,000 wildlife observers who require over

Burlington County

3.0 million recreation-days per year. Although it is not known to what extent this demand is satisfied, a large portion of public land and 23 miles of hiking trails contribute to the growing need for outdoor recreation experiences.

Overall, current recreational demands approach 3.5 million man-days per year. It appears that the need for outdoor experiences will increase due to rising incomes, increasing leisure time and the need to escape the pressures of urban/suburban living. This will accelerate pressure on undeveloped areas.

Camden County

In 1976, the sale of freshwater fishing licenses numbered 8,542. According to the 1975 National Survey, this resulted in 209,279 fisherman-days per year. State revenue generated from the sale of licenses totaled $75,390.

County hunters, as estimated by 1976 license sales, numbered 9,766 firearm hunters and 2,215 archery hunters. According to the 1975 National Survey, this resulted in 241,130 hunter-days per year. State revenue generated from the sale of licenses totaled $119,810.

The 1,729 acre Camden County portion of the Winslow Fish and Wildlife Management Area is important in satisfying the hunter demand. In addition, there are over 14,000 acres available for hunting in Wharton State Forest.

Camden County

The furbearer resource survey for the county revealed that revenue generated from the sale of raw furs totaled $24,867. There were 58 trapping licenses issued, and a total of 4,286 man-days of recreation were derived from trapping. State revenue generated from the sale of licenses totaled $580. Major furbearers include muskrat, raccoon and opossum.

Non-consumptive forms of outdoor recreation, which included bird watching, wildlife photography and nature hikes, are in great demand. From the county's 1973 population (i.e., 471,343) and according to the 1975 National Survey, it is estimated that there are presently 126,000 wildlife observers who require 4.0 million recreation-days per year. Although it is not known to what extent this demand is satisfied, it appears that the recreational needs cannot fully be met by existing open space.

Overall, current recreational requirements approach 4.5 million man-days per year. It appears that future recreational demands will increase due to rising incomes, increasing leisure time and the need to escape the pressures of urban/suburban living. At the same time, recreational opportunities will decrease with continued degradation of water quality and loss of open space to development. This will result in county residents seeking recreational opportunities elsewhere.

Gloucester County

In 1976, the sale of freshwater fishing licenses numbered 5,040.

Gloucester County

According to the 1975 National Survey, this resulted in 123,480 fisherman-days per year. State revenue generated from the sale of licenses totaled $43,936.

County hunters, as estimated by 1976 license sales, numbered 7,790 firearm hunters and 1,386 archery hunters. According to the 1975 National Survey, this resulted in 188,495 hunter-days per year. State revenue generated from the sale of licenses totaled $91,760.

There are 4,411 acres of State Fish and Wildlife Management Areas in the county. It appears that this limited acreage will cause hunters to utilize private land or land outside the county to satisfy their hunting requirements.

The furbearer resource survey for the county revealed that revenue generated from the sale of raw furs totaled $209,053. There were 405 trapping licenses issued, and a total of 21,655 man-days of recreation were derived. State revenue generated from the sale of licenses totaled $4,050. Major furbearers include muskrat, raccoon, red fox, gray fox, mink, skunk, opossum and weasel.

Non-consumptive forms of outdoor recreation, which include birdwatching, wildlife photography and nature hikes, are in great demand. From the county's 1973 population (i.e., 180,285) and the 1975 National Survey, it is estimated that there are presently 48,000 wildlife observers who experience

Gloucester County

over 1.5 million recreation-days per year. Although it is not known to what extent this demand is satisfied, it appears that outdoor activities cannot be met by existing public land.

Overall, current recreational demands exceed 1.8 million man-days per year. It appears that future recreational requirements will increase due to rising incomes, increasing leisure time and the need to escape the pressures of urban/suburban living. Since the present amount of open space available for outdoor recreation is limited, there will be a need for county residents to seek these opportunities elsewhere.

SUMMARY

A. Habitat Description

1. Aquatic

a. Description of Basins: There are 19 basins contained within Burlington, Camden and Gloucester Counties, draining an area of approximately 1,366 mi^2. All the basins are exorheic. The Crosswicks, Blacks, Crafts, Assiscunk, Rancocas, Pompeston/Swede, Pennsauken, Cooper, Newton, Big Timber, Woodbury, Mantua, Repaupo, Raccoon, Maple Swamp and Oldmans are sub-basins to the Delaware drainage. The Maurice drains into Delaware Bay and the Great Egg Harbor and Mullica Rivers drain into the Atlantic Ocean. Only the headwater regions of the Maurice and Great Egg Harbor are located in the study area. Overall, the region supports a population of approximately one million people.

Land use in the study area varies from being heavily urbanized along the Delaware River to the forested Pine Barrens. Agricultural land is common throughout much of the region. Suburban development, however, is competing for undeveloped land and becoming more prevalent.

Summary

b. Water Quality: EPA STORET Water Quality Data and 208 Water Quality Studies indicate severe water quality problems in the study area. Although varying with drainage basin, water quality violations (as established by the 208 Regional Water Quality Management Program) include DO, NH_3-N, TP, pH and fecal coliform. Overall, these violations stem primarily from point source discharging into the water system. Point sources include industrial, municipal and non-municipal discharges. In addition, numerous site-specific, non-point source discharges are located within the study area. These include landfills, industrial storage tank areas, lagoons, septic tank systems, feedlots and spray irrigation sites. Further, the associated runoff from suburban and agricultural areas greatly increases concentrations of organic, sediment and sediment-related pollutants. Sedimentation is severe in agricultural areas where protective riparian vegetation has been removed, degrading water quality in the immediate area as well as downstream.

Although macroinvertebrate composition and distribution is controlled by environmental conditions and varies considerably, benthic samples show high con-

Summary

centrations of organisms tolerant of organic pollution. Common species include hydrosychid larvae, chironomid larvae, tubificid worms, leeches and aquatic earthworms.

c. Lotic: Upstream segments of the study basins flow primarily through agricultural/forested areas and expanding suburban development before draining into the Delaware River or the Atlantic Ocean. These tributaries average two feet or less in depth and are approximately 10 feet wide. Agricultural practices, including the removal of protective riparian vegetation, have degraded many of these streams by accelerating bank erosion and sedimentation. Substrate conditions have been altered as the stream flows through these areas. In undisturbed reaches, substrate consists mostly of mud, sand and gravel. Ditching and diking for irrigational purposes have also altered the lotic ecosystem.

Upstream segments of the Crosswicks, Blacks, Crafts, Assiscunk, Rancocas, Pompeston/Swede, Pennsauken, Cooper, Newton and Big Timber Rivers are classified as FW-2 waters, while upstream segments of the Woodbury, Mantua, Repaupo, Raccoon, Oldmans, Maurice and Great Egg Harbor Rivers are classified as FW-5

Summary

waters by the New Jersey Department of Environmental Protection. All parkland (e.g., State Fish and Wildlife Management Areas) are classified as FW-1 waters. Further, several headwater tributaries of the Rancocas and the upstream segments of the Mullica River are classified as FW-Central Pine Barrens Waters.

Tidal segments are characteristic of wetlands and mud flats. In the tidal channels, mean width ranges from 10 to 800 feet and mean depth is about four feet. Tidal segments of the Crosswicks, Blacks, Crafts, Assiscunk, Rancocas, Oldmans, and Mullica Rivers are classified as TW-1 waters and tidal segments of the Pompeston/Swede, Pennsauken, Cooper, Newton, Big Timber, Woodbury, Mantua, Repaupo, Raccoon and Maple Swamp are classified as TW-2 waters.

Extensive floodplain areas along the watercourses are characteristic of the New Jersey Coastal Plain. Continued development on the floodplain has accelerated storm runoff and has increased peak discharges.

A segment of Raccoon Creek and Big Timber Creek (i.e., Big Lebanon Run) are the only lotic habitat stocked

Summary

with trout in the study area.

d. Lentic: Numerous lakes and minor impoundments are contained in the study area. Many of these impoundments originated as old dammed millponds, cranberry bogs, gravel pits, farm ponds, from diking, mining of bog ore and other disturbances. Most of the lakes are shallow and mean depth is approximately five feet. Human activities in the basins have accelerated the eutrophication process, and in some situations hypereutrophy exists. Phytoplankton levels may be exceptionally high during the summer. Siltation and excessive aquatic plant growth are common. Aquatic vegetation consists of bladderwort, waterlily, spatterdock, watermilfoil, duckweed, elodea, pickerelweed, arrow-arum, arrowhead, pondweed and cattail. Although all impoundments in the study area are potentially eutrophic, several lakes in the Pine Barrens illustrate dystrophic characteristics.

Present trout stocking is limited to a "put-and-take" fishery in lakes within the Maurice, Raccoon, Repaupo, Big Timber, Cooper, Rancocas and Oldmans drainage basins. Previous stocking consisted mainly of largemouth bass/sunfish, channel catfish

Summary

and trout.

2. Terrestrial

The study area lies within the Inner and Outer Coastal Plains of New Jersey. Elevations are generally under 200 feet. Topography is mostly flat with some scattered hills. Soil types consist primarily of unconsolidated sand, gravel, clay and marl, with sandier conditions in the Outer Coastal Plain.

The study area contains three major types of vegetational community structure. A mixed oak forest type prevails in the western portion, mixed oak-pine forests are contained in the middle regions and the Pine Barrens are located in the eastern portions. Associates of the mixed oak forest type vary with site but normally include American beech, yellow-poplar, red maple and various hickories. Transition zones of mixed oak-pine forest types occur as pitch pine becomes more prevalent in the stand. Associates of the mixed oak-pine forest type vary with site but normally include pitch pine, shortleaf pine, scarlet, white, chestnut, blackjack, post, black and scrub oaks. Virginia pine is found along the edges of the pitch pine stands. Although pitch pine stands are most characteristic of the Barrens, several forest types are recognized. These include Atlantic

Summary

white-cedar swamps, maple-gum-magnolia swamps, pitch pine lowland forests on moist sites and pine-blackjack oak, pine-oak and oak-pine on dry or upland sites. Understory vegetation, including herbaceous communities, vary with each of these different site conditions.

Diverse vegetational communities are found on abandoned agricultural fields during various successional stages. Common pioneer species include grasses and sedges, goldenrod, blackberry, sumac, eastern redcedar, gray birch, poison ivy, red maple, sassafras and black cherry.

B. Species Composition

1. Fishes

Continued degradation of the aquatic habitat has limited the diverse fish populations that were once supported by these watercourses. Fish kills are common. Anadromous spawning runs of blueback herring and alewife are restricted due to water quality problems and man-made barriers. Confirmed runs are limited to the Crosswicks, Blacks, Rancocas, Mantua, Raccoon, Oldmans and Mullica Rivers. However, nursery habitat in other basins may be utilized by anadromous fish. Actual spawning runs of American shad no longer exist.

Summary

Fish populations are composed primarily of rough fish. Species composition varies with drainage basin and may include resident, anadromous and several introduced species (i.e., bowfin, rainbow trout, brown trout, tiger muskie, goldfish, carp, channel catfish, burbot, rock bass, green sunfish, warmouth, bluegill, smallmouth bass, largemouth bass, white crappie, black crappie).

Fish populations supported by upstream segments of the Mullica, Great Egg Harbor, Maurice and Rancocas that flow through the Pine Barrens are composed of species tolerant of acid waters (e.g., mud sunfish, blackbanded sunfish, banded sunfish, swamp darter, chain pickerel).

2. Wildlife

Wetland habitat contained in the study area supports a wide variety of aquatic and terrestrial organisms. Tidal marsh provides food and cover for many wildlife species, including wading birds, shorebirds, raptorial species, migratory waterfowl, muskrats, mice and Norway rats. Dredge spoil deposits and dense communities of common reed greatly decrease the productivity and the potential of a viable wildlife population in these marsh areas.

In developed areas, the pressure of residential, commercial and industrial activities has resulted in the ex-

Summary

tirpation of several species, leaving as residents urban tolerant wildlife (e.g., gray squirrel, common crow, Norway rat, herring gull, robin, starling, house sparrow, dark-eyed junco and snapping turtle).

Overall, the forested/agricultural areas, abandoned farmland, marshes and undisturbed sections of the Pine Barrens provide the best wildlife habitat in the study area. These areas provide for food, breeding and territorial requirements.

C. Threatened or Endangered Species

Although only occurring as a winter visitor (Mullica) or transient (Crosswicks), the bald eagle and, as a transient (Mullica), the peregrine falcon are the only Federally-designated endangered species known to occur in the study area. In addition, the osprey, Cooper's hawk, eastern tiger salamander, bog turtle and the Pine Barrens treefrog, which are reported to occur in the study area, are classified by the State of New Jersey as endangered. These species have all been reported to occur in the Pine Barrens and associated habitats. The osprey was also observed in Crosswicks Creek marsh. The Pine Barrens treefrog has been nominated for the Federal Endangered Species List. Further, Knieskern's beaked-rush, found in the Pine Barrens, has also been nominated for the Federal Endangered Species List.

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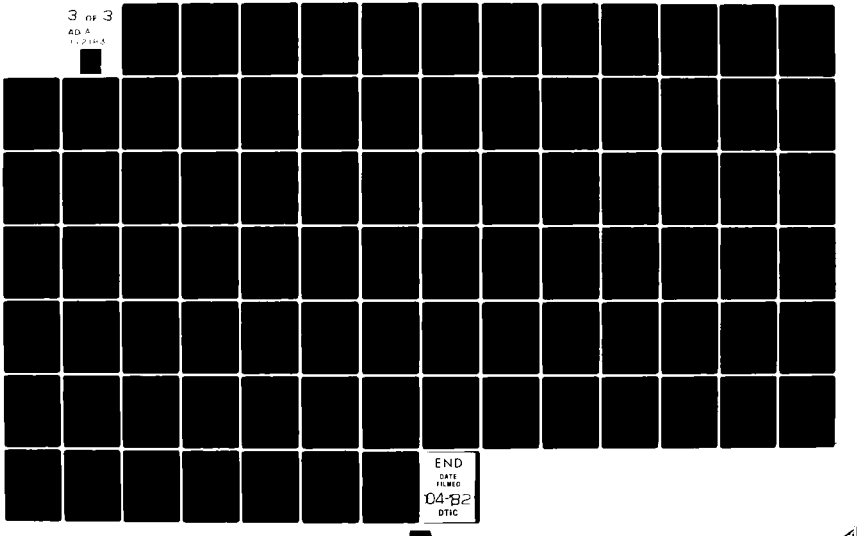

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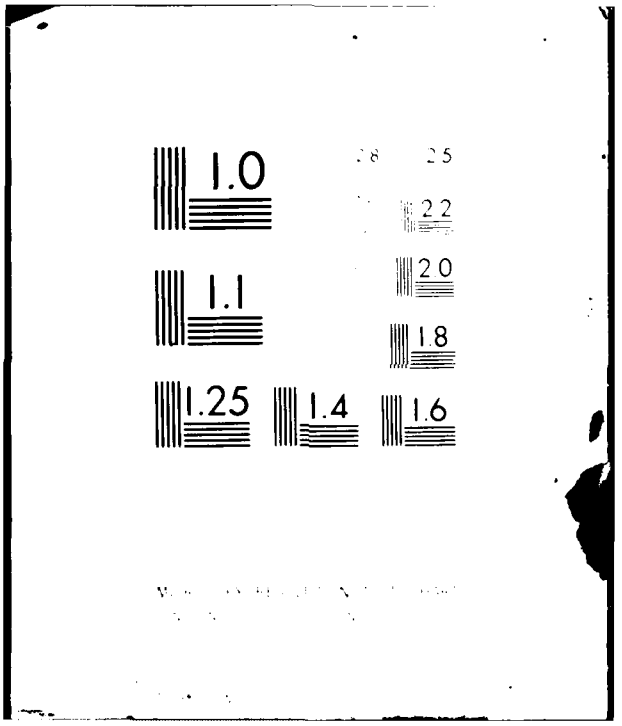
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Summary

There is the possibility that the shortnose sturgeon, a Federally endangered species, may occur near the watercourses' confluence with the Delaware River.

D. Important and Unique Habitats

The most ecologically important areas within the study area consist of undisturbed wetland habitat, including Atlantic white-cedar swamps and marshes, nursery habitat supporting anadromous fish, undisturbed lotic habitat, undisturbed terrestrial habitat adjacent to abandoned fields, natural riparian habitat, the Pine Barrens and the Pine Barrens aquifer. The Pine Barrens and associated habitats are considered unique and should be protected from further degradation.

The Mullica and segments of the Rancocas, Maurice and Great Egg Harbor Rivers have been suggested for study and consideration by the State New Jersey as wild and scenic rivers under the Wild and Scenic Rivers Act (P.L. 90-542). Furthermore, two legislative bills (i.e., H.R. 6625; H.R. 9535/9539) have been introduced in Congress concerning the protection of the Pine Barrens. A considerable amount of this area is currently proposed for development.

E. Public Use

Based on the 1975 National Survey of Hunting, Fishing and

Summary

Wildlife-Associated Recreation and the most recent data available for the study area, participants engaged in these activities totaled 325,346 people. This resulted in almost 10 million recreation-days per year. Furthermore, the State revenue generated from the sale of hunting, fishing and trapping licenses totaled over one-half million dollars.

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A P P E N D I C E S

APPENDIX A

Vegetation

Tables A-1 to A-4 denote the trees, shrubs, aquatic vegetation and rare plants reported to occur within the study area. A more detailed description of vegetational communities, including historic, floristic and systematic characters are discussed in Witmer Stone's volume (1910) published by the New Jersey State Museum, "The Plants of Southern New Jersey, with Especial Reference to the Flora of the Pine Barrens and the Geographic Distribution of the Species."

Authoritative botanical source used for scientifie names:

Fernald, M.L. 1950. Gray's Manual of Botany, Eighth Edition, American Book Co., New York. 1632 pp.

APPENDIX TABLE A-1

Trees Reported to Occur Within the Study Area

Common Name	Scientific Name
Ash, black	Fraxinus nigra Marsh.
Ash, green	Fraxinus pennsylvanica Marsh.
Ash, white	Fraxinus americana L.
Aspen, bigtooth	Populus grandidentata Michx.
Aspen, quaking	Populus tremuloides Michx.
Basswood, American	Tilia americana L.
Beech, American	Fagus grandifolia Ehrh.
Birch, black	Betula lenta L.
Birch, gray	Betula populifolia Marsh.
Birch, river	Betula nigra L.
Box-elder	Acer negundo L.
Butternut	Juglans cinerea L.
Cedar, Atlantic white-	Chamaecyparis thyoides (L.) B.S.P.
Cherry, black	Prunus serotina Ehrh.
Chestnut, American (sprouts)	Castanea dentata (Marsh.) Borkh.
Cucumbertree	Magnolia acuminata L.
Dogwood, flowering	Cornus florida L.
Elm, American	Ulmus americana L.
Elm, slippery	Ulmus rubra Mühl.
Gum, black	Nyssa sylvatica Marsh.
Hackberry, common	Celtis occidentalis L.
Hemlock, eastern	Tsuga canadensis (L.) Carr.
Hickory, bitternut	Carya cordiformis (Wangenh.) K.Koch
Hickory, mockernut	Carya tomentosa Nutt.
Hickory, pignut	Carya glabra (Mill.) Sweet
Hickory, sand	Carya pallida (Ashe) Engl. and Graebn.
Hickory, shagbark	Carya ovata (Mill.) K.Koch
Holly, American	Ilex opaca Ait.
Hophornbeam	Ostrya virginiana (Mill.) K.Koch
Hoptree, three-leaved	Ptelea trifoliata L.

Appendix Table A-1

Common Name	Scientific Name
Ironwood	Carpinus caroliniana Walt.
Locust, black	Robinia pseudoacacia L.
Locust, honey	Gleditsia triacanthos L.
Maple, red	Acer rubrum L.
Maple, Norway	Acer platanoides L.
Maple, silver	Acer saccharinum L.
Maple, sugar	Acer saccharum Marsh.
Mulberry, red	Morus rubra L.
Mulberry, white	Morus alba L.
Oak, black	Quercus velutina Lam.
Oak, blackjack	Quercus marilandica Muenchh.
Oak, chestnut	Quercus prinus L.
Oak, pin	Quercus palustris Meunchh.
Oak, post	Quercus stellata Wangenh.
Oak, scarlet	Quercus coccinea Muenchh.
Oak, scrub	Quercus ilicifolia Wangenh.
Oak, scrub chestnut	Quercus prinoides Willd.
Oak, southern red	Quercus falcata Michx.
Oak, spanish	Quercus triloba Michx.
Oak, swamp chestnut	Quercus michauxii Nutt.
Oak, swamp post	Quercus stellata Wang.
Oak, swamp white	Quercus bicolor Muhl.
Oak, white	Quercus alba L.
Oak, willow	Quercus phellos L.
Papaw	Asimina triloba L.
Persimmon	Diospyros virginiana L.
Pine, loblolly	Pinus taeda L.
Pine, pitch	Pinus rigida Mill.
Pine, pond	Pinus serotina Michx.
Pine, shortleaf	Pinus echinata Mill.
Pine, Virginia	Pinus virginiana Mill.

Appendix Table A-1

Common Name	Scientific Name
Plum, wild yellow	Prunus americana Marsh.
Sassafras	Sassafras albidum (Nutt.) Nees.
Serviceberry	Amelanchier areonea (Michx.) F.Fern.
Sweetgum	Liquidambar styraciflua L.
Sycamore	Platanus occidentalis L.
Walnut, black	Juglans nigra L.
Willow	Salix spp. L.
Yellow-poplar	Liriodendron tulipifera L.

APPENDIX TABLE A-2

Shrubs Reported to Occur Within the Study Area

Common Name	Scientific Name
Alder, black	Ilex verticillata L.
Arrow-wood	Viburnum dentatum L.
Bayberry	Myrica carolinensis Mill.
Blackberry	Rubus spp. L.
Blackhaw	Viburnum prunifolium L.
Bladdernut	Staphylea trifolia L.
Blueberry	Vaccinium spp. L.
Burning bush	Enonymus atropurpureus Jacq.
Chokeberry, black	Aronia nigra (Willd.)
Chockberry, red	Aronia arbutifolia L.
Cranberry, large	Vaccinium macrocarpon Ait.
Crowberry, Conrad's	Corema conradii Torr.
Deerberry	Vaccinium stamineum L.
Dewberry	Rubus villosus Ait.
Dewberry, single-flowered	Rubus villosus enslenii Tratt.
Dogwood, alternate-leaved	Cornus alternifolia L.
Dogwood, flowering	Cornus florida L.
Dogwood, panicled	Cornus paniculata L'Her.
Dogwood, silky	Cornus amomum Mill.
Elder, American	Sambucus canadensis L.
Grape	Vitis spp. L.
Greenbrier	Smilax rotundifolia L.
Greenbrier, glaucous-leaved	Smilax glauca Walt.
Greenbrier, laurel-leaved	Smilax laurifolia L.
Greenbrier, Walter's	Smilax walteri Pursh.
Hazel, American	Corylus americana Walt.
Holly, mountain	Nemopanthus mucronata (L.) Trel.
Honeysuckle, coral	Lonicera sempervirens L.
Inkberry	Ilex glabra L.
Ivy, poison	Rhus radicans L.
Leatherleaf	Chamaedaphne calyculata Moench.
Myrtle, sand	Leiophyllum buxifolium (Berg.) Ell.

Appendix Table A-2

Common Name	Scientific Name
Mountain-laurel	Kalmia latifolia L.
New Jersey tea	Ceanothus americanus L.
Pepperbush	Clethra alnifolia L.
Plum, beach	Prunus maritima Wang.
Redbud	Cercis canadensis L.
Rhododendron	Rhododendron maximum L.
Rose, low	Rosa humilis Marsh.
Rose, swamp	Rosa carolina L.
Shadbush	Amelanchier canadensis (L.) Medic.
Spicebush	Lindera benzoin (L.) Blume
Sumac, dwarf	Rhus copallina L.
Sumac, poison	Rhus vernix L.
Sumac, smooth	Rhus glabra L.
Sumac, staghorn	Rhus typhina L.
Sweetbay	Magnolia virginiana L.
Sweet-fern	Comptonia peregrina (L.) Coult.
Teaberry	Gaultheria procumbens L.
Thorn	Crataegus spp. L.
Viburnum, maple leaf	Viburnum acerifolium L.
Winterberry	Ilex Verticillata (L.) Gray
Witch-hazel	Hamamelis virginia L.
Withe-rod	Viburnum cassinoides L.

APPENDIX TABLE A-3

Aquatic Plants Reported to Occur Within the Study Area

Common Name	Scientific Name
Freshwater Communities:	
Arrow-arum	Peltandra virginica (L.) Kunth.
Arrowhead	Sagittaria latifolia Willd.
Bladderwort	Utriclaria spp. L.
Cattail, narrow-leaved	Typha augustifolia L.
Cattail, broad-leaved	Typha latifolia L.
Common reed	Phragmites communis Trin.
Duckweed	Lemna spp. L.
Elodea	Elodea canadensis Michx.
Marsh hibiscus	Hibiscus moscheutos L.
Pickerelweed	Pontederia cordata L.
Pondweed	Potamogeton spp. (Tourn.) L.
Small cranberry	Vaccinium oxycoccus L.
Spatterdock	Nuphar advena Ait.
Sphagnum moss	Sphagnum spp. Dill
Watermilfoil	Myriophyllum spp. (Vaill.) L.
Water moss	Frontinalis spp. Dill.
Wildrice	Zizania aquatica L.

Appendix Table A-3

Common Name	Scientific Name
Estuarine Communities:	
Black grass	Juncus gerardi Lois.
Bulrush	Scirpus spp. (Tourn.) L.
Common reed	Phragmites communis Trin.
Cordgrass	Spartina alterniflora Loi.-Desl.
Dwarf saltwort	Salicornia bigelouii L.
Marsh flebane	Pluchea purpurascens (Swartz) DeCand.
Salthay	Spartina patens (Ait.) Muhl.
Slender glasswort	Salicornia europaea L.
Spikegrass	Distichlis spicata (L.) Green

APPENDIX TABLE A-4

Rare Plants Reported to Occur Within the Study Area

Common Name	Scientific Name
Adam-and-Eve	Aplectrum hyemale (Mulhl.) Torr.
Adder's tongue	Ophioglossum vulgatum L.
Arrowhead, slender	Sagittaria teres S. Wats.
Aster, silvery	Aster concolor L.
Beaked-rush, Knieskern's	Rhynchospora knieskernii Carey
Beaked-rush, slender	Rhynchospora inundata (Oakes) Fern.
Bladderwort	Utricularia resupinata Green
Bladderwort, purple	Utricularia purpurea Walt.
Blazing star	Liatris graminifolia (Walt.) Willd.
Bulrush, Long's	Scirpus longii Fern.
Bulrush, salt-marsh	Scirpus maritimus L.
Canby's lobelia	Lobelia canbyi Gray
Chaffseed	Schwalbea americana L.
Climbing fern	Lygodium palmatum (Bernh.) Sw.
Crowberry, broom	Coroma conradii Torr.
False asphodel	Tofieldia racemosa (Walt.) BSP.
Fern, curly grass	Schizea pusilla Pursh.
Floating heart	Nymphoides cordata (Ell.) Fern.
Goldenrod, Elliott's	Solidago elliottii T. and G.
Goldenrod, wand-like	Solidago stricta Ait.
Grass, broad-leaved beard	Gymnopogon ambigus (Michx.) BSP.
Grass, Wright's panic	Panicum wrightianum Scribr.
Grass-leaved ladies' tresses	Spiranthes praecox (Walt.) S.Wats.
Little ladies' tresses	Spiranthes tuberosa Raf.
Meadow-beauty	Rhexia aristosa Britt.
Milkweed, red	Asclepias rubra L.
Milkweed, white	Asclepias variegata L.
Milkwork, pink	Polygala incarnata L.
Mistletoe, American	Phoradendron flavescens (Pursh.) Nutt.

Appendix Table A-4

Common Name	Scientific Name
Morning glory, Pickering	Breweria pickeringii (M.A.Curtis)
Orchid, crane-fly	Tipularia discolor (Pursh.) Nutt.
Orchid, crested fringed	Habenaria cristata (Michx.) R.Br.
Orchid, southern yellow	Habenaria integra (Nutt.) Spreng.
Orchid, yellow fringed	Habenaria ciliaris (L.) R.Br.
Parker's pipewort	Eriocaulon parkeri Robins
Pine Barrens gentian	Gentiana autumnalis L.
Rattlesnake root	Chamaelirium luteum (L.) Gray
Recticulated nut rush	Scleria reticularis Michx.
Rose-colored tickseed	Coreopsis rosea Nutt.
Rushfoil	Crotonopsis elliptica Willd.
Rush, spike	Eleocharis diandra C. Wright
Rush, spike	Eleocharis equisefoides (Ell.) Torr.
Rush, spike twisted	Eleocharis tortilis (Link) Schultes
Rush, Torrey's	Juncus torreyi Coville
Sand myrtle	Leiophyllum buxifolium (Berg.) Ell.
Sedge, Barratt's	Carex barrattii Schwein. and Torr.
Sedge, Drummon's	Fimbristylis drummondii Boeckl.
Sedge, Umbrella	Cyperus brevifolius (Rottb.) Hassek.
Slender rattlesnake root	Prenanthes autumnalis Walt.
Small cranberry	Vaccinium oxycoccos L.
Spreading pogonia	Cleistes divaricata (L.) Ames.
Stiff tick-trefoil	Desmodium strictum (Pursh.) DC.
Turkey-beard	Xerophyllum asphodeloides L.
Twayblade, large	Liparis lilifolia (L.) Richard
Twayblade, Loesel's	Liparis loeselii (L.) Richard
Waterwort	Elatine americana (Pursh.) Arn.
Yellow-eyed grass	Xyris fimbriata Ell.

APPENDIX B

Fishes

Tables (B-2 to B-20c) denote fish species composition by weight and number, computed from data collected by the New Jersey Department of Environmental Protection, Lebanon Fisheries Laboratory.

Table B-1 lists scientific names and additional species reported to occur within the study area. The abbreviations used in Table B-1 are defined as follows:

i - indicates an introduced species
ri - indicates a re-introduced species
* - indicates a Federal and State endangered species

Authoritative source used for scientific names:

Bailey, R.M., J.E. Fitch, E.S. Herald, E.A. Lachner, C.C. Lindsey, C.R. Robins and W.B.Scott, 1970. A List of Common and Scientific Names of Fishes from the United States and Canada, Third Edition, American Fisheries Society, Special Publication No. 6. Washington, D.C. 150 pp.

APPENDIX TABLE B-1

Scientific Names of Fishes

Common Name	Scientific Name
Petromyzontidae - lampreys	
American brook lamprey	*Lampetra lamottei*
Acipenseridae - sturgeons	
Shortnose sturgeon*	*Acipenser brevirostrum*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Anquillidae - freshwater eels	
American eel	*Anguilla rostrata*
Amiidae - bowfins	
Bowfin[i]	*Amia calva*
Clupeidae - herrings	
Blueback herring	*Alosa aestivalis*
Hickory shad	*Alosa mediocris*
American shad	*Alosa sapidissima*
Alewife	*Alosa pseudoharengus*
Atlantic menhaden	*Brevoortia tyrannus*
Gizzard shad	*Dorosoma cepedianum*
Engraulidae - anchovies	
Bay anchovy	*Anchoa mitchilli*
Salmonidae - trouts	
Brook trout[ri]	*Salvelinus fontinalis*
Rainbow trout[i]	*Salmo gairdneri*
Brown trout[i]	*Salmo trutta*

Appendix Table B-1

Common Name	Scientific Name
Umbridae - mudminnows	
Eastern mudminnow	*Umbra pygmaea*
Esocidae - pikes	
Redfin pickerel	*Esox americanus americanus*
Chain pickerel	*Esox niger*
Tiger muskie[i]	*Esox masquinongy x Esox lucius*
Cyprinidae - minnows and carps	
Goldfish[i]	*Carassius auratus*
Carp[i]	*Cyprinus carpio*
Silvery minnow	*Hybognathus nuchalis*
Golden shiner	*Notemigonus crysoleucas*
Satinfin shiner	*Notropis analostanus*
Bridled shiner	*Notropis bifrenatus*
Ironcolor shiner	*Notropis chalybaeus*
Common shiner	*Notropis cornutus*
Spottail shiner	*Notropis hudsonius*
Swallowtail shiner	*Notropis procne*
Spotfin shiner	*Notropis spilopterus*
Steelcolor shiner	*Notropis whipplei*
Bluntnose minnow	*Pimephales notatus*
Blacknose dace	*Rhinichthys atratulus*
Creek chub	*Semotilus atromaculatus*
Fallfish	*Semotilus corporalis*
Ictaluridae - freshwater catfishes	
White catfish	*Ictalurus catus*
Yellow bullhead	*Ictalurus natalis*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish[i]	*Ictalurus punctatus*
Tadpole madtom	*Noturus gyrinus*

Appendix Table B-1

Common Name	Scientific Name
Gadidae - codfishes	
Burbot	*Lota lota*
Cyprinodontidae - killifishes	
Banded killifish	*Fundulus diaphanus*
Mummichog	*Fundulus heteroclitus*
Striped killifish	*Fundulus majalis*
Rainwater killifish	*Lucania parva*
Gasterosteidae - sticklebacks	
Fourspine stickleback	*Apeltes quadracus*
Percichthyidae - temperate basses	
White perch	*Morone americana*
Striped bass	*Morone saxatilis*
Centrachidae - sunfishes	
Mud sunfish	*Acantharchus pomotis*
Rock bass[i]	*Ambloplites rupestris*
Blackbanded sunfish	*Enneacanthus chaetodon*
Bluespotted sunfish	*Enneacanthus gloriosus*
Banded sunfish	*Enneacanthus obesus*
Redbreast sunfish	*Lepomis auritus*
Green sunfish[i]	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Warmouth[i]	*Lepomis gulosus*
Bluegill[i]	*Lepomis macrochirus*
Redear sunfish	*Lepomis microlophus*
Smallmouth bass[i]	*Micropterus dolomieui*

Appendix Table B-1

Common Name	Scientific Name
Centrachidae - sunfishes	
Largemouth bass[i]	*Micropterus salmoides*
Black crappie[i]	*Pomoxis nigromaculatus*
White crappie[i]	*Pomoxis annularis*
Percidae - perches	
Swamp darter	*Etheostoma fusiforme*
Tessellated darter	*Etheostoma olmstedi*
Yellow perch	*Perca flavescens*
Walleye	*Stizostedion vitreum vitreum*
Pomatomidae - bluefishes	
Bluefish	*Pomatomus saltatrix*
Sciaenidae - drums	
Spot	*Leiostomus xanthurus*

APPENDIX TABLE B-2

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Crosswicks Creek | Sub-Basin: Crosswicks | Drainage: Delaware | Date: 9/9/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 75 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Muck, sand

Water Temp.(°F): 73 | DO(ppm): 6.0 | pH: 7.5 | Conductivity(mho@25°C): 210

Location: Bordentown Boat Launch, upstream from confluence with Delaware | Township: Bordentown | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	20		20.00		10.00		17.78	
Blueback herring	1		1.00		< 0.06		0.11	
Alewife	1		1.00		< 0.06		0.11	
Tiger muskie (>12")	1		1.00		2.00		3.56	
Carp (>1 lb.)	6		6.00		30.00		53.33	
Silvery minnow	32		32.00		1.52		2.70	
Golden shiner	3		3.00		0.55		0.98	
White sucker (yoy)	1	3	1.00	3.00	0.10	3.60	0.18	6.40
(>12")	2		2.00		3.50		6.22	
White perch (yoy)	1		1.00		< 0.06		0.11	
(<7")	9	13	9.00	13.00	2.30	3.86	4.09	6.87
(>7")	3		3.00		1.50		2.67	
Redbreast sunfish (<5")	2	3	2.00	3.30	0.15	0.45	0.27	0.80
(>5")	1		1.00		0.30		0.53	
Pumpkinseed (<5")	6	7	6.00	7.00	0.15	0.35	0.27	0.63
(>5")	1		1.00		0.20		0.36	
Largemouth bass (<9")	1	5	1.00	5.00	0.15	3.35	0.27	5.96
(>9")	4		4.00		3.20		5.69	
Black crappie (<5")	3	5	3.00	5.00	0.10	0.45	0.18	0.80
(>5")	2		2.00		0.35		0.62	
Total	100		100.00		56.25		100.03	

APPENDIX TABLE B- 3a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Blacks Creek - Bacon Run | Sub-Basin: Blacks | Drainage: Delaware | Date: 9/9/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 30 | $\bar{x}$ depth(in.): 24 | Gradient: Slight | Substrate: Sand, muck

Water Temp.(°F): 73 | DO(ppm): 6.0 | pH: 7.5 | Conductivity(mho@25°C): 210

Location: Bordentown Boat Launch Area | Township: Bordentown | County: Burlington

Near Confluence with Delaware River

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	75	28.96	12.75	47.13
Blueback herring	35	13.51	0.35	1.29
Alewife	8	3.09	0.15	0.55
Silvery minnow	100	38.61	10.25	37.89
Spottail shiner	25	9.65	0.35	1.29
White sucker (< 12")	8	3.09	0.95	3.51
White catfish (> 7")	1	0.39	1.00	3.70
Brown bullhead (> 7")	1	0.39	0.65	2.40
Redbreast sunfish (< 5")	3	1.16	0.30	1.11
Pumpkinseed (< 5")	2	0.77	0.20	0.74
Black crappie (< 5")	1	0.39	0.10	0.37
Total	259	100.01	27.05	99.98

APPENDIX TABLE B-3b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Blacks Creek - Bacons Run Sub-Basin: Blacks Drainage: Delaware Date: 6/11/75
Length of Stretch(ft.): 600 $\bar{x}$ width(ft.): 25 $\bar{x}$ depth(in.): 6 Gradient: Slight Substrate: Sand, gravel
Water Temp.(°F): 63 DO(ppm): 10.0 pH: 7.3 Conductivity(mho@25°C): 160
Location: Old York Road Bridge Township: Bordentown & Mansfield County: Burlington

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	10	13.33	4.50	44.03
Redfin pickerel (< 12")	1	1.33	0.15	1.47
Goldfish (< 1 lb.)	4	5.33	1.25	12.23
Carp (yoy)	1 } 2	1.33 } 2.66	0.35 } 1.35	3.42 } 13.20
(> 1 lb.)	1	1.33	1.00	9.78
Common shiner	1	1.33	<0.06	0.59
Spottail shiner	25	33.33	0.25	2.45
Fallfish	6	8.00	0.40	3.91
White sucker (yoy)	3 } 9	4.00 } 12.00	0.10 } 1.60	0.98 } 15.66
(< 12")	6	8.00	1.50	14.68
Green sunf.sh (< 5")	1	1.33	0.10	98
Pumpkinseed (< 5")	12	16.00	0.15	1.47
Bluegill (yoy)	3	4.00	<0.06	.59
Largemouth bass (> 9")	1	1.33	0.35	3.47
Total	75	99.97	10.22	100.00

APPENDIX TABLE B-4

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Crafts Creek | Sub-Basin: Crafts | Drainage: Delaware | Date: 9/9/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 100 | $\bar{x}$ depth(in.): 36 | Gradient: Slight | Substrate: Mud

Water Temp.(°F): 70 | DO(ppm): 3.0 | pH: 6.5 | Conductivity(mho@25°C): 220

Location: Immediately above confluence with Delaware River | Township: Bordentown | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	12		3.45		6.15		4.80	
Blueback herring	100 (estimated)		28.74		1.00		0.82	
Carp (> 1 lb.)	10		2.87		80.00		62.43	
Silvery minnow	95		27.30		3.45		2.69	
Golden shiner	3		0.86		0.45		0.35	
Spottail shiner	22		6.32		0.60		0.47	
White catfish (> 7")	1		0.29		1.20		0.94	
Brown bullhead (> 7")	1		0.29		0.75		0.59	
White perch (yoy)	25		7.18		0.25		0.20	
(< 7")	40	80	11.49	22.98	8.50	15.50	6.63	12.10
(> 7")	15		4.31		6.75		5.27	
Pumpkinseed (< 5")	7	9	2.01	2.58	0.25	0.60	0.20	0.47
(> 5")	2		0.57		0.35		0.27	
Largemouth bass (< 9")	3	15	0.86	4.31	0.45	18.45	0.35	14.40
(> 9")	12		3.45		18.00		14.05	
Total	348		99.99		128.15		100.06	

APPENDIX TABLE B-5

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Assiscunk Creek | Sub-Basin: Assiscunk | Drainage: Delaware | Date: 9/11/75

Length of Stretch(ft.): 1200 | $\bar{x}$ width(ft.): 60 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Muck

Water Temp.(°F): 72 | DO(ppm): 6.0 | pH: 7.3 | Conductivity(mho@25°C): 220

Location: Curtin Marina- Upstream from confluence with Delaware River | Township: Burlington | County: Burlington

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	25	10.78	5.50	7.69
Blueback herring	16	6.90	0.25	0.35
Chain pickerel (>12")	3	1.29	4.75	6.64
Carp (>1 lb.)	6	2.59	35.00	48.96
Golden shiner	9	3.88	1.25	1.75
Spottail shiner	3	1.29	< 0.06	0.08
Silvery minnow	24	10.34	0.95	1.33
Spottail shiner	2	0.86	< 0.06	0.08
White sucker (<12")	1	0.43	0.75	1.05
(>12")	4	1.72	5.00	6.99
White catfish (>7")	1	0.43	2.00	2.80
White perch (yoy)	100	43.10	0.50	0.70
(<7")	5	2.16	0.75	1.05
(>7")	1	0.43	0.50	0.70
Pumpkinseed (<5")	4	1.72	0.25	0.35
(>5")	6	2.59	1.00	1.40
Largemouth bass (yoy)	1	0.43	< 0.06	0.08
(<9")	2	0.86	0.75	1.05
(>9")	6	2.59	9.50	13.29
Black crappie (<5")	1	0.43	0.15	0.21
(>5")	2	0.86	0.30	0.42
Walleye (>12")	2	0.86	2.10	2.94
Banded killifish	8	3.45	< 0.06	0.08
Total	232	99.99	71.49	99.99

APPENDIX TABLE B- 6a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: SW Branch - Rancocas Sub-Basin: Rancocas Drainage: Delaware Date: 8/14/75

Length of Stretch(ft.): 300 $\bar{x}$ width(ft.): 100 $\bar{x}$ depth(in.): 36 Gradient: Slight Substrate: Sand, gravel

Water Temp.(°F): DO(ppm): 6.0 pH: 6.3 Conductivity(mho@25°C): 80

Location: Gatehole Below Kirby's Mill Pond Township: Medford County: Burlington
County Rd. 616

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	6		12.50		2.50		17.49	
Chain pickerel (yoy)	1		2.08		< 0.06		0.42	
(< 12")	3	5	6.25	10.41	0.10	1.36	0.70	9.52
(> 12")	1		2.08		1.20		8.40	
Carp (< 1 lb.)	1	2	2.08	4.16	0.50	5.50	3.50	38.49
(> 1 lb.)	1		2.08		5.00		34.99	
Spottail shiner	1		2.08		< 0.06		0.42	
White sucker (< 12")	2		4.17		0.35		2.45	
Yellow bullhead (> 7")	1		2.08		0.40		2.80	
Redbreast sunfish (< 5")	2		4.17		0.30		2.10	
Pumpkinseed (yoy)	3		6.25		< 0.06		0.42	
(< 5")	9	15	18.75	31.25	0.35	0.86	2.45	6.02
(> 5")	3		6.25		0.45		3.15	
Bluegill (< 5")	4		8.33		0.10		0.70	
Largemouth bass (yoy)	1		2.08		< 0.06		0.42	
(< 9")	1	4	2.08	8.33	0.25	2.06	1.75	14.42
(> 9")	2		4.17		1.75		12.25	
Black crappie (< 5")	1		2.08		0.20		1.38	
Yellow perch (< 7")	2	5	4.17	10.42	0.10	0.60	0.70	4.20
(> 7")	3		6.25		0.50		3.50	
Total	48		99.98		14.29		99.99	

APPENDIX TABLE B-6b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: South Branch Rancocas | Sub-Basin: Rancocas | Drainage: Delaware | Date: 8/13/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 35 | $\bar{x}$ depth(in.): 36 | Gradient: Slight | Substrate: Sand, muck

Water Temp.(°F): 76 | DO(ppm): 4.6 | pH: 4.3 | Conductivity(mho@25°C): 60

Location: Route 206 Bridge | Township: South Hampton | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	6		13.33		2.00		31.50	
Chain pickerel (yoy)	25		59.84		0.10		1.57	
(< 12")	3	28	7.14	69.36	0.20	1.50	3.15	23.62
(> 12")	1		2.38		1.20		18.90	
[illegible] (> 9")	2		4.76		1.50		23.62	
Yellow bullhead (> 7")	3		7.14		1.00		15.75	
[illegible] (> 3")	2		4.76		0.35		5.51	
Total	42		99.35		6.35		100.00	

APPENDIX TABLE B-6c

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
CCLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Rancocas-Greenwood Lake | Sub-Basin: Rancocas | Drainage: Delaware | Date: 8/1/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 16 | $\bar{x}$ depth(in.): 36 | Gradient: Slight | Substrate: Sand, muck

Water Temp.(°F): 73 | DO(ppm): 6.6 | pH: 4.8 | Conductivity(mho@25°C): 50

Location: Main St. Bridge, New Lisbon County Rd. 646 | Township: Pemberton | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	4		3.60		2.65		39.61	
Redfin pickerel (<12")	4		3.60		0.30		4.48	
Chain pickerel (yoy)	6		5.41		<0.06		0.90	
(<12")	12	21	10.81	18.92	0.75	3.01	11.21	44.99
(>12")	3		2.70		2.20		32.88	
Mudminnow	2		1.80		<0.06		0.90	
Pirate perch	20		18.02		0.30		4.48	
Blackbanded sunfish	6		5.41		<0.06		0.90	
Banded sunfish	50		45.05		0.25		3.74	
Swamp darter	4		3.60		<0.06		0.90	
Total	111		100.00		6.69		100.00	

APPENDIX TABLE B-6d

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: North Branch Rancocas | Sub-Basin: Rancocas | Drainage: Delaware | Date: 7/31/75

Length of Stretch(ft.): 3000 | $\bar{x}$ width(ft.): 50 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Sand, Muck

Water Temp.(°F): 74 | DO(ppm): 7.4 | pH: 6.5 | Conductivity(mho@25°C): 60

Location: Main St. Smithville | Township: East Hampton | County: Burlington

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	8	4.37	3.50	8.42
Chain pickerel (yoy)	4	2.19	< 0.06	0.14
Carp (> 1 lb.)	1	0.55	24.00	57.73
Golden shiner (yoy)	100] 102	54.64] 55.73	0.35] 0.65	0.84] 1.56
(Adult)	2]	1.09]	0.30]	0.72]
Creek chubsucker (> 9")	1	0.55	0.65	1.56
White sucker (> 12")	3	1.64	5.60	13.47
Pumpkinseed (yoy)	50]	27.32]	0.20]	0.48]
(< 5")	6] 59	3.28] 32.24	0.50] 1.20	1.20] 2.88
(> 5")	3]	1.64]	0.50]	1.20]
Bluegill (< 5")	2] 3	1.09] 1.64	< 0.06] 0.31	0.14] 0.74
(> 5")	1]	0.55]	0.25]	0.60]
Largemouth bass (< 9")	1] 2	0.55] 1.10	0.10] 5.60	0.24] 13.47
(> 9")	1]	0.55]	5.50]	13.23]
Total	183	100.01	41.57	99.97

APPENDIX TABLE B-6e

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: North Branch - Rancocas Sub-Basin: Rancocas Drainage: Delaware Date: 7/2/75

Length of Stretch(ft.): 600 $\bar{x}$ width(ft.): 65 $\bar{x}$ depth(in.): 36 Gradient: Slight Substrate: Sand, muck

Water Temp.(°F): 72 DO(ppm): 8.0 pH: 7.0 Conductivity(mho@25°C): 60

Location: County Rd. 530, Mount Holly Township: Mount Holly County: Burlington

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	100	37.74	25.00	15.89
Chain pickerel (>12")	2	0.75	2.50	1.59
Goldfish (> 1 lb.)	1	0.38	1.20	0.76
Carp (> 1 lb.)	15	5.66	105.00 (estimated)	66.73
Golden shiner (yoy)	100] 112	37.74] 42.27	0.50] 3.50	0.32] 2.23
(adult)	12	4.53	3.00	1.91
Creek chubsucker (> 9")	1	0.38	1.00	0.64
Brown bullhead (> 7")	2	0.75	2.00	1.27
White perch (< 7")	10] 11	3.77] 4.15	1.25] 1.55	0.79] 0.98
(> 7")	1	0.38	0.30	0.19
Redbreast sunfish (> 5")	1	0.38	0.20	0.13
Pumpkinseed (< 5")	5] 8	1.89] 3.02	0.25] 0.70	0.16] 0.45
(> 5")	3	1.13	0.45	0.29
Bluegill (< 5")	1	0.38	0.10	0.06
Largemouth bass (> 9")	7	2.64	14.25	9.06
Black crappie (< 5")	2] 3	0.75] 1.13	0.15] 0.30	0.10] 0.20
(> 5")	1	0.38	0.15	0.10
Swamp darter	1	0.38	< 0.06	0.04
Total	265	100.01	157.36	100.03

APPENDIX TABLE B-6f

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Rancocas Creek | Sub-Basin: Rancocas | Drainage: Delaware | Date: 9/12/75

Length of Stretch(ft.): 1,200 | $\bar{x}$ width(ft.): 200 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Sand

Water Temp.(°F): 73 | DO(ppm): 8.0 | pH: 7.5 | Conductivity(mho@25°C): 200

Location: Riverside, N.J. (Delanco) State Road 543 | Township: Delanco | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	10		8.77		1.75		5.38	
Blueback herring	16		14.04		0.10		0.31	
Gizzard shad	1		0.88		0.75		2.31	
Carp (>1 lb)	3		2.63		10.75		33.05	
Golden shiner	4		3.51		0.75		2.31	
Satinfin shiner	5		4.39		< 0.06		0.18	
Spottail shiner	2		1.75		< 0.06		0.18	
White sucker (< 12")	4	5	3.51	4.39	1.20	2.70	3.69	8.30
(>12")	1		0.88		1.50		4.61	
White catfish (> 7")	6		5.26		5.00		15.37	
Banded killifish	3		2.63		< 0.06		0.18	
White perch (> 7")	7	13	6.14	11.40	2.50	3.75	7.69	11.53
(< 7")	6		5.26		1.25		3.84	
Pumpkinseed (< 5")	2	9	1.75	7.89	0.20	1.05	0.61	3.22
(> 5")	7		6.14		0.85		2.61	
Bluegill (< 5")	1	2	0.88	1.76	0.10	0.35	0.31	1.08
(>5")	1		0.88		0.25		0.77	
Largemouth bass (<9")	1	3	0.88	2.63	0.15	3.90	0.46	11.99
(>9")	2		1.75		3.75		11.53	
Smallmouth bass (< 9")	1		0.88		0.30		0.92	
Silvery minnow	31		27.19		1.20		3.69	
Total	114		100.00		32.53		100.00	

APPENDIX TABLE B-7a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Pompeston Run | Sub-Basin: Pompeston/Swede | Drainage: Delaware | Date: 10/5/77

Length of Stretch(ft.): 300 | $\bar{x}$ width(ft.): 8 | $\bar{x}$ depth(in.): 8 | Gradient: - | Substrate: Rocky, gravel

Water Temp.(°F): 59 | DO(ppm): 9.8 | pH: 7.3 | Conductivity(mho@25°C): 180

Location: Rt. 130 - Bridge | Township: Cinnaminson | County: Burlington

Taxon	Number	Percent by Number	Weight (Grams)	Percent by Weight
Pumpkinseed (>5")	3] 153	0.78] 39.54	0.30] 3.30	4.89] 53.83
(<5")	150	38.76	3.00	48.94
Bluegill (<5")	4	1.03	<0.06	0.98
Catfish	7	1.81	0.20	3.26
[illegible]	15	3.88	1.00	16.31
Banded killifish	145	37.47	1.00	16.31
Satinfin shiner	16	4.13	0.06	0.98
Silvery minnow	1	0.26	<0.06	0.98
Green sunfish (<5")	46	11.89	0.45	7.34
Total	387	100.01	6.13	99.99

APPENDIX TABLE B-7b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Swede Run | Sub-Basin: Pompeston /Swede | Drainage: Delaware | Date: 10/5/77

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 8 | $\bar{x}$ depth(in.): 10 | Gradient: ----- | Substrate: Sand, gravel

Water Temp.(°F): 58 | DO(ppm): 10.2 | pH: 7.2 | Conductivity(mho°25°C): 150

Location: Conrow Rd. Bridge | Township: Delran | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Redfin Pickerel (< 12")	3		0.95		0.40		2.60	
Brown bullhead (< 7")	2		0.63		0.23		1.63	
Pumpkinseed (> 5")	2		0.63		0.45		1.63	
(< 5")	10	27	3.16	8.54	0.20	0.55	1.30	3.58
(yoy)	15		4.75		0.10		0.65	
Redbreast sunfish (> 5")	6	21	1.90	6.65	0.75	1.35	4.88	8.78
(< 5")	15		4.75		0.60		3.90	
Chubsucker (< 9")	7		2.22		0.70		4.55	
Largemouth bass (yoy)	1		0.32		< 0.06		0.39	
American eel	35		11.08		10.00		65.06	
Mudminnow	1		0.32		< 0.06		0.39	
Satinfin shiner	8		2.53		0.30		1.95	
Banded killifish	10		3.16		< 0.06		0.39	
Tessellated darter	12		3.80		< 0.06		0.39	
Satinfin shiner	2		0.63		< 0.06		0.39	
Spottail shiner	4		1.27		< 0.06		0.39	
Bridled shiner	173		54.75		0.40		2.60	
White sucker (< 12")	4	10	1.27	3.17	1.00	1.06	6.51	6.90
(yoy)	6		1.90		0.06		0.39	
Total	316		100.02		15.37		99.99	

APPENDIX TABLE B-8a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Pennsauken-North Branch Sub-Basin: Pennsauken Drainage: Delaware Date: 10/1/75

Length of Stretch(ft.): 300 $\bar{x}$ width(ft.): 50 $\bar{x}$ depth(in.): 24 Gradient: Slight Substrate: Sand, gravel

Water Temp.(°F): 68 DO(ppm): 5.6 pH: 6.8 Conductivity(mho@25°C): 190

Location: Outfall below Strawbridge Lake Township: Moorestown County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Goldfish (yoy)	1	3	1.67	5.00	0.10	2.10	1.83	38.46
(> 1 lb.)	2		3.33		2.00		36.63	
Carp (yoy)	1	2	1.67	3.34	0.10	1.10	1.83	20.15
(> 1 lb.)	1		1.67		1.00		18.32	
Creek Chubsucker (< 5")	1		1.67		0.25		4.58	
Yellow Bullhead (> 5")	1		1.67		0.20		3.66	
Pumpkinseed (< 5")	38	40	63.33	66.66	1.00	1.30	18.32	23.81
(> 5")	2		3.33		0.30		5.49	
Bluegill (yoy)	6		10.00		< 0.06		1.10	
(< 5")	2	11	3.33	18.33	0.10	0.41	1.83	7.51
(> 5")	3		5.00		0.25		4.58	
Largemouth bass (yoy)	2		3.33		0.10		1.83	
Total	60		100.00		5.46		100.00	

APPENDIX TABLE B-8b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Pennsauken, South Branch | Sub-Basin: Pennsauken | Drainage: Delaware | Date: 10/1/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 12 | $\bar{x}$ depth(in.): 6 | Gradient: Slight | Substrate: Sand, gravel

Water Temp.(°F): | DO(ppm): | pH: | Conductivity(mho@25°C): 260

Location: Church Road | Township: Maple Shade | County: Burlington - Camden line

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
Mudminnow	8	9.88	0.10	0.52
Goldfish (yoy)	6] 56	7.41] 69.14	0.35] 18.35	1.84] 96.28
(< 1 lb.)	50]	61.73]	18.00]	94.44]
Golden shiner	12	14.81	0.45	2.36
Creek chubsucker	4	4.94	0.10	0.52
Bluegill (yoy)	1	1.23	< 0.06	0.31
Total	81	100.00	19.06	99.99

APPENDIX TABLE B-9a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Cooper River | Sub-Basin: Cooper | Drainage: Delaware | Date: 7/2/76

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 25 | $\bar{x}$ depth(in.): 12 | Gradient: Slight | Substrate: Mud, silt, gravel

Water Temp.(°F): 72 | DO(ppm): 7.6 | pH: 7.5 | Conductivity(mho@25°C): 230

Location: King's Highway Bridge | Township: Cherry Hill | County: Camden

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	15		8.67		0.75		2.99	
Goldfish (<1 lb.)	20	25	11.56	14.45	14.25	19.25	56.82	76.76
(>1 lb.)	5		2.89		5.00		19.94	
Carp (<1 lb.)	4	5	2.31	2.89	1.00	2.25	3.99	8.97
(>1 lb.)	1		0.58		1.25		4.98	
[illegible]	8		4.62		0.55		2.19	
Satinfin shiner	2		1.16		< 0.06		0.24	
White sucker (<12")	5	6	2.89	3.47	0.75	1.90	2.99	7.58
(>12")	1		0.58		1.15		4.59	
Brown bullhead (yoy)	100	(estimated)	57.80		0.10		0.40	
Banded killfish	2		1.16		< 0.06		0.24	
Pumpkinseed (<5")	8		4.62		0.10		0.40	
Largemouth bass (yoy)	2		1.16		< 0.06		0.24	
Total	173		100.00		25.08		100.01	

APPENDIX TABLE B-9b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Cooper River - North Branch | Sub-Basin: Cooper | Drainage: Delaware | Date: 7/2/76

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 15 | $\bar{x}$ depth(in.): 12 | Gradient: Slight | Substrate: Mud

Water Temp.(°F): 72 | DO(ppm): 5.4 | pH: 7.5 | Conductivity(mho@25°C): 220

Location: King's Highway Bridge | Township: Cherry Hill | County: Camden

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
American eel	100 (estimated)		42.55		18.25		27.51	
Goldfish (<1 lb.)	25	33	10.64	14.04	15.35	25.60	23.13	38.58
(>1 lb.)	8		3.40		10.25		15.45	
Carp (<1 lb.)	1		0.43		0.50		0.75	
[illegible]	75		31.91		4.50		6.78	
White sucker (<12")	15	25	6.38	10.64	1.25	16.25	1.88	24.49
(>12")	10		4.26		15.00		22.61	
Brown bullhead (>1 lb.)	1		0.43		1.25		1.88	
total	235		100.00		66.35		99.99	

APPENDIX TABLE B-10

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Newton Creek Sub-Basin: Newton Drainage: Delaware Date:

Length of Stretch(ft.): $\bar{x}$ width(ft.): $\bar{x}$ depth(in.): Gradient: Substrate:

Water Temp.(°F): DO(ppm): pH: Conductivity(mho@25°C):

Location: Township: County:

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
No Recent Sampling Data Available				

APPENDIX TABLE B-11a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Big Timber Creek - North Branch | Sub-Basin: Big Timber | Drainage: Delaware | Date: 7/9/76

Length of Stretch(ft.): 300 | $\bar{x}$ width(ft.): 3 | $\bar{x}$ depth(in.): 10 | Gradient: ---- | Substrate: Sand, gravel

Water Temp.(°F): 74 | DO(ppm): 7.0 | pH: 6.8 | Conductivity(mho@25°C): 100

Location: Laurel Mills Road Bridge | Township: Stratford | County: Camden

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	50	27.62	3.50	11.36
Goldfish (< 1 lb.)	11	6.08	4.55	14.76
Carp (> 1 lb.)	4	2.21	4.25	13.79
Golden shiner	3	1.66	0.25	0.81
[illegible] (< 12")	9 - 11	4.97 - 6.07	1.25 - 3.05	4.06 - 9.90
(> 12")	2	1.10	1.80	5.84
[illegible] (< 7")	6 - 8	3.31 - 4.41	0.80 - 2.55	2.59 - 8.28
(> 7")	2	1.10	1.75	5.68
White perch (< 7")	5	2.76	0.35	1.14
Redbreast sunfish (< 5")	8 - 13	4.42 - 7.18	0.40 - 1.15	1.30 - 3.73
(> 5")	5	2.76	0.75	2.43
Pumpkinseed (< 5")	5	2.76	0.30	0.97
Bluegill (< 5")	24 - 41	13.26 - 22.65	1.15 - 3.35	3.73 - 10.87
(> 5")	17	9.39	2.20	7.14
Largemouth bass (yoy)	15	8.29	0.25	0.81
(< 9")	10 - 28	5.52 - 15.47	4.75 - 7.12	15.41 - 23.10
(> 9")	3	1.66	2.12	6.88
Black crappie (> 5")	2	1.10	0.40	1.30
Total	181	99.97	30.82	100.01

APPENDIX TABLE B-11b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Big Timber Creek - North Branch | Sub-Basin: Big Timber | Drainage: Delaware | Date: 7/14/76

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 18 | $\bar{x}$ depth(in.): 6 | Gradient: Slight | Substrate: Mud, clay, gravel

Water Temp.(°F): 70 | DO(ppm): 7.4 | pH: 6.9 | Conductivity(mho@25°C): 90

Location: Lakeland Ave. Bridge | Township: Lakeland | County: Camden

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	25	29.76	6.25	56.92
Satinfin shiner	4	4.76	< 0.06	0.55
Spottail shiner	24	28.57	0.35	3.19
Golden shiner	3	3.57	0.65	5.92
Brown bullhead (>7")	1	1.19	1.00	9.11
Redbreast sunfish (<5")	1	1.19	< 0.06	0.55
Redbreast sunfish (<5")	16] 21	19.05] 25.00	1.00] 2.25	9.11] 20.49
(>5")	5	5.95	1.25	11.38
Pumpkinseed (< 5")	1	1.19	< 0.06	0.55
Bluegill (< 5")	3] 4	3.57] 4.76	0.10] 0.30	0.91] 2.73
(>5")	1	1.19	0.20	1.82
Total	84	99.99	10.98	100.01

APPENDIX TABLE B-11c

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Big Timber Creek | Sub-Basin: Big Timber | Drainage: Delaware | Date: 9/5/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 100 | $\bar{x}$ depth(in.): 72 | Gradient: Slight | Substrate: Muck, sand

Water Temp.(°F): 72 | DO(ppm): 3.4 | pH: 6.8 | Conductivity(mhos@25°C): 270

Location: Route 47 Bridge - Gloucester City | Township: Gloucester | County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	100 (estimated)	29.33	75.00 (estimated)	88.96
Alewife	14	4.11	0.15	0.18
Gizzard shad	1	0.29	0.15	0.18
Goldfish (< 1 lb.)	1	0.29	0.65	0.77
Carp (> 1 lb.)	1	0.29	3.25	3.85
Silvery minnow	49	14.37	0.65	0.77
Brown bullhead (> 7")	1	0.29	1.00	1.19
Banded killifish	27	7.92	0.30	0.36
Mosquitofish	134	32.30	0.50	0.59
White perch (yoy)	1	0.29	< 0.06	0.07
(< 7")	1	0.29	0.35	0.42
(> 7")	1	0.29	0.50	0.59
Striped bass (< 7")	1	0.29	0.25	0.30
Pumpkinseed (< 5")	3	0.88	0.35	0.42
(> 5")	5	1.47	1.00	1.19
Bluegill (> 5")	1	0.29	0.15	0.18
Total	341	[illegible]	84.31	100.02

APPENDIX TABLE B-12

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Woodbury Creek | Sub-Basin: Woodbury | Drainage: Delaware | Date: 10/5/77

Length of Stretch(ft.): 300 | $\bar{x}$ width(ft.): 6 | $\bar{x}$ depth(in.): 4 | Gradient: - | Substrate: Sand with heavy siltation

Water Temp.(°F): 64 | DO(ppm): 8.6 | pH: 5.9 | Conductivity(mho°25°C): 220

Location: Bridge at Route 45 | Township: Woodbury | County: Gloucester

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Gizzard shad	3		23.08		0.40		32.00	
Brown bullhead (>7")	1		7.69		0.50		40.00	
Pumpkinseed (>5")	1	9	7.69	69.23	0.15	0.35	12.00	28.00
(<5")	8		61.54		0.20		16.00	
Total	13		100.00		1.25		100.00	

APPENDIX TABLE B- 13

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Mantua Creek | Sub-Basin: Mantua | Drainage: Delaware | Date: 6/10/76

Length of Stretch(ft.): 3000 | $\bar{x}$ width(ft.): 50 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Mud

Water Temp.(°F): 71 | DO(ppm): 5.2 | pH: 6.4 | Conductivity(mho@25°C): 230

Location: Mount Royal Boat Launch | Township: East Greenwich | County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	1	0.62	0.10	0.98
Silvery minnow	28	17.39	0.75	7.38
Sportail shiner	1	0.62	< 0.06	0.59
White sucker (> 12")	1	0.62	1.50	14.76
Banded killifish	100 (estimated)	62.11	3.50	34.45
White perch (< 3")	18] 24	11.18] 14.91	2.50] 3.75	24.61] 36.91
(> 3")	6	3.73	1.25	12.30
Pumpkinseed (< 5")	5	3.11	0.30	2.95
Yellow perch	1	0.62	0.20	1.97
Total	161	100.00	10.16	99.99

APPENDIX TABLE B- 14

FISH SPECIES COMPOSITION BY WEIG. T AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Repaupo Sub-Basin: Repaupo Drainage: Delaware Date:

Length of Stretch(ft.): $\bar{x}$ width(ft.): $\bar{x}$ depth(in.): Gradient: Substrate:

Water Temp.(°F): DO(ppm): pH: Conductivity(mho@25°C):

Location: Township: County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
No Recent Sampling Data Available				

APPENDIX TABLE B-15a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Raccoon Creek | Sub-Basin: Raccoon | Drainage: Delaware | Date: 7/14/76

Length of Stretch(ft.): 300 | $\bar{x}$ width(ft.): 15 | $\bar{x}$ depth(in.): 8 | Gradient: Slight | Substrate: Sand, gravel

Water Temp.(°F): 72 | DO(ppm): 7.2 | pH: 7.4 | Conductivity(mho@25°C): 160

Location: U.S. Rt. 322 Bridge | Township: Mullica Hill | County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	12	13.33	.75	7.25
Chain pickerel (<12")	3] 4	3.33] 4.44	0.20] 0.55	0.41] 2.27
(>12")	1	1.11	0.45	1.86
Goldfish (<1 lb.)	4	4.44	1.50	6.21
Carp (>1 lb.)	3	3.33	11.00	53.83
Silvery minnow	5	5.44	< 0.06	1.25
Golden shiner	12	13.33	0.15	0.62
Satinfin shiner	11	12.22	0.30	1.24
Bridled shiner	6	6.66	< 0.06	0.25
Common shiner	1	1.11	< 0.06	0.25
Pumpkinseed	17	18.89	2.25	9.32
White sucker (<12")	11] 12	12.22] 13.33	1.50] 4.20	11.49] 17.39
(>12")	1	1.11	0.70	2.90
Bluegill (<5")	1	1.11	0.15	0.62
Bluegill (<5")	2	2.22	< 0.06	0.25
Largemouth bass (yoy)	1	1.11	< 0.06	0.25
Total	90	99.96	24.15	100.00

APPENDIX TABLE B-15b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Raccoon Creek | Sub-Basin: Raccoon | Drainage: Delaware | Date: 9/4/75

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 150 | $\bar{x}$ depth(in.): 48 | Gradient: Slight | Substrate: Sand, muck

Water Temp.(°F): 74 | DO(ppm): 4.5 | pH: 6.9 | Conductivity(mho@25°C): 300

Location: Bridgeport Boat Yard, Upstream from confluence with Delaware | Township: Bridgeport | County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
Blueback herring (yoy)	2	1.41	< 0.06	0.33
Gizzard shad (adult)	2	1.41	1.25	6.80
Bay anchovy	3	2.11	< 0.06	0.33
Goldfish (yoy)	2] 5	1.41] 3.52	< 0.06] 1.06	0.33] 5.77
(< 1 lb.)	3	2.11	1.00	5.44
Carp (< 1 lb.)	3] 6	2.11] 4.22	0.25] 12.25	1.36] 66.65
(> 1 lb.)	3	2.11	12.00	65.29
Silvery minnow	112	78.87	1.50	8.16
Brown bullhead (> 7")	1	0.70	1.00	5.44
Banded killifish	6	4.23	0.20	1.09
White perch (< 7")	3] 4	2.11] 2.81	0.50] 0.80	2.72] 4.35
(> 7")	1	0.70	0.30	1.63
Pumpkinseed (> 3")	1	0.70	0.20	1.09
Total	142	99.98	18.38	100.01

APPENDIX TABLE B-16

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Maple Swamp Sub-Basin: Maple Swamp Drainage: Delaware Date:

Length of Stretch(ft.): $\bar{x}$ width(ft.): $\bar{x}$ depth(in.): Gradient: Substrate:

Water Temp.(°F): DO(ppm): pH: Conductivity(mho@25°C):

Location: Township: County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
No Recent Sampling Data Available				

APPENDIX TABLE B-17

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Oldmans Creek | Sub-Basin: Oldmans | Drainage: Delaware | Date: 7/15/76

Length of Stretch(ft.): 600 | $\bar{x}$ width(ft.): 12 | $\bar{x}$ depth(in.): 12 | Gradient: Slight | Substrate: Sand, gravel

Water Temp.(°F): 72 | DO(ppm): 7.2 | pH: 7.5 | Conductivity(mho@25°C): 180

Location: County Road 7 Bridge | Township: South Harrison | County: Gloucester

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
American eel	30	25.21	10.25	44.96
Chain pickerel (yoy)	3	2.52	0.10	0.44
Carp (> 1 lb.)	3	2.52	4.50	19.74
Satinfin shiner	6	5.04	< 0.06	0.26
Common shiner	8	6.72	0.10	0.44
Bridled shiner	7	5.88	< 0.06	0.26
[illegible]	20	16.81	0.25	1.10
Fallfish	13	10.92	1.00	4.39
White sucker (yoy)	2	1.68	< 0.06	0.26
(< 12")	5 (15)	4.20 (12.60)	0.65 (5.56)	2.85 (24.38)
(> 12")	8	6.72	4.85	21.27
Redbreast sunfish (< 5")	5 (7)	4.20 (5.88)	0.30 (0.80)	1.32 (3.51)
(> 5")	2	1.68	0.50	2.19
Large mouth bass (yoy)	1	0.84	< 0.06	0.26
Unidentified darter	6	5.04	< 0.06	0.26
Total	119	99.98	22.80	100.00

APPENDIX TABLE B-18

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Maurice | Sub-Basin: Maurice | Drainage: Atlantic | Date: 5/11/77

Length of Stretch(ft.): 3,000 | $\bar{x}$ width(ft.): 150 | $\bar{x}$ depth(in.): 48 | Gradient: - | Substrate: Sand, gravel

Water Temp.(°F): 60 | DO(ppm): 9.8 | pH: 7.2 | Conductivity(mho @25°C): 100

Location: Above Union Lake | Township: Vineland | County: Cumberland

Taxon	Number	Percent by Number	Weight (pounds)	Percent by Weight
Carp (>1 lb.)	1	1.04	3.25	3.42
White sucker	25	26.04	75.00 (estimated)	78.90
American eel	6	6.25	2.45	2.58
Yellow perch (>7")	2] 17	2.08] 17.71	0.75] 3.90	0.79] 3.10
(<7")	15]	15.63]	3.15]	3.31]
White perch (<7")	10	10.42	2.25	2.37
Creek chub (>9")	3] 9	3.13] 9.38	2.70] 3.35	2.84] 3.52
(<9")	6]	6.25]	0.65]	0.68]
Pumpkinseed (>5")	2] 8	2.08] 8.33	0.35] 0.50	0.37] 0.53
(<5")	6]	6.25]	0.15]	0.16]
Bluegill (>5")	1] 5	1.04] 5.21	0.20] 0.35	0.21] 0.37
(<5")	4]	4.17]	0.15]	0.16]
Chain pickerel	2	2.08	1.75	1.84
Brown bullhead (>7")	3	3.13	1.75	1.84
Banded killifish	1	1.04	<0.06	0.06
Redbreast sunfish (>5")	3] 9	3.13] 9.38	0.30] 0.45	0.32] 0.48
(<5")	6]	6.25]	0.15]	0.16]
Total	96	100.01	95.06	100.01

APPENDIX TABLE B-19

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Great Egg Harbor | Sub-Basin: Great Egg | Drainage: Atlantic | Date: 6/14/77

Length of Stretch(ft.): 3000 | $\bar{x}$ width(ft.): 300 | $\bar{x}$ depth(in.): 36 | Gradient: ---- | Substrate: Sand, gravel

Water Temp.(°F): 74 | DO(ppm): 8.8 | pH: 6.7 | Conductivity(mho @25°C): 90-120

Location: Below Lenape Lake | Township: Hamilton | County: Atlantic

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Yellow perch (>7")	20	75	14.60	54.75	5.25	9.00	23.23	39.82
(<7")	55		40.15		3.75		16.59	
Brown bullhead (>9")	5		3.65		3.45		15.27	
Chain pickerel (>12")	1	2	0.73	1.46	2.25	2.40	9.96	10.62
(<12")	1		0.73		0.15		0.66	
Pumpkinseed (>5")	10	25	7.30	18.24	2.15	3.35	9.51	14.82
(<5")	15		10.94		1.20		5.31	
White sucker (>12")	1		0.73		2.65		11.73	
White perch (>7")	2		1.46		1.75		7.74	
Golden shiner	1		0.73		--		--	
American eel	25		18.25		--		--	
Banded sunfish	1		.73		--		--	
Total	137				22.60		100.00	

APPENDIX TABLE B-20a

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM SEINING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Mullica River | Sub-Basin: Mullica | Drainage: Atlantic | Date: 8/26/77

Length of Stretch(ft.): | $\bar{x}$ width(ft.): 50 | $\bar{x}$ depth(in.): 36 | Gradient: ----- | Substrate: Sand, gravel

Water Temp.(°F): 76 | DO(ppm): 8.0 | pH: 5.4 | Conductivity(mho@25°C): 50

Location: Atsion Lake Gatehole | Township: Shamong | County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Chain pickerel (>12")	1		0.63		0.55		33.95	
(<12")	4	6	2.53	3.79	0.45	1.06	27.78	65.43
(yoy)	1		0.63		<0.06		3.70	
Black banded sunfish	50		31.65		0.15		9.26	
Pumpkinseed (yoy)	1		0.63		<0.06		3.70	
Creek chubsucker	100 (estimated)		63.29		0.10		6.17	
Brown bullhead (>7")	1		0.63		0.25		15.43	
Total	158		99.99		1.62		99.99	

APPENDIX TABLE B-20b

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM ELECTROFISHING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Mullica Sub-Basin: Mullica Drainage: Atlantic Date: 7/18/77

Length of Stretch(ft.): 3000 $\bar{x}$ width(ft.): 300 $\bar{x}$ depth(in.): 3.6 Gradient: ---- Substrate: Sand, gravel

Water Temp.(°F): 87 DO(ppm): 7.6 pH: 6.1 Conductivity(mho@25°C): 200

Location: (Sweetwater) Crowleytown Boat Launch Township: Washington County: Burlington

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Alewife	50		15.87		0.30		0.20	
White sucker (>12")	50		15.87		100.00	(estimated)	66.97	
(<12")	25	95	7.94	30.16	113.50 12.00	(estimated)	8.04	76.03
(yoy)	20		6.35		1.50	(estimated)	1.00	
Chain pickerel (>12")	2		0.63		2.50		1.67	
(yoy)	10	13	3.17	4.12	0.75	3.60	0.50	2.40
(<12")	1		0.32		0.35		0.23	
Yellow perch (>7")	6	31	1.90	9.84	1.25	3.00	0.84	2.01
(<7")	25		7.94		1.75		1.17	
White perch (>7")	5	35	1.59	11.11	2.75	8.00	1.84	5.36
(<7")	30		9.52		5.25		3.52	
Creek chubsucker (>9")	3	15	0.95	4.76	1.75	2.00	1.17	1.34
(<9")	12		3.81		0.25		0.17	
Golden shiner	50		15.87		15.00	(estimated)	10.05	
Banded killifish	10		3.17		< 0.06		0.04	
White catfish	2		0.63		0.65		0.44	
Brown bullhead (>7")	2		0.63		1.20		0.80	
[illegible] (>5")	8	12	2.54	3.81	1.75	2.00	1.17	1.34
(<5")	4		1.27		0.25		0.17	
Total	315		99.97		149.31		99.99	

APPENDIX TABLE B-20c

FISH SPECIES COMPOSITION BY WEIGHT AND NUMBER FROM SEINING DATA
COLLECTED BY THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, LEBANON FISHERIES LABORATORY

Stream: Oswego-Wading/Mullica Sub-Basin: Mullica Drainage: Atlantic Date: 9/1/77

Length of Stretch(ft.): $\bar{x}$ width(ft.): 35 $\bar{x}$ depth(in.): 36 Gradient: ---- Substrate: Sandy, gravel

Water Temp.(°F): 76 DO(ppm): 8.0 pH: 4.5 Conductivity(mho@25°C): 60

Location: Wharton State Forest Township: Shamong County: Burlington

County 963

Taxon	Number		Percent by Number		Weight (pounds)		Percent by Weight	
Chain pickerel (<12")	2	3	11.76	17.64	0.25	0.31	43.86	54.39
(yoy)	1		5.88		<0.06		10.53	
Creek chubsucker (<9")	1	13	5.88	76.47	0.10	0.16	17.54	28.07
(yoy)	12		70.59		<0.06		10.53	
[illegible] (<3")	1		5.88		0.10		17.54	
Total	17		99.99		0.57		100.00	

APPENDIX C

Wildlife

The following table denotes the reported occurrence of wildlife species in each drainage basin within the study area. The table does not indicate the relative abundance of any of these species. The abbreviations used in the table are defined as follows:

- x - presence of a wildlife species in a drainage basin
- i - indicates introduced species
- * - indicates a Federally-designated endangered or threatened species
- ** - indicates a New Jersey listed endangered species
- t - indicates a New Jersey listed threatened species

Authoritative sources used for scientific names:

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Heintzelman, D.S., 1970. The Hawks of New Jersey, New Jersey State Museum, Bulleton 13. Trenton, N.J. 103 pp.

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Basins listed according to the following wildlife Appendix Table

1. Crosswicks
2. Blacks
3. Crafts
4. Assiscunk
5. Rancocas
6. Pompeston/Swede
7. Pennsauken
8. Cooper
9. Newton
10. Big Timber
11. Woodbury
12. Mantua
13. Repaupo
14. Raccoon
15. Maple Swamp
16. Oldmans
17. Maurice
18. Great Egg Harbor
19. Mullica

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES- Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Common loon	Gavia immer					X	X										X	X	X	
Red-throated loon	Gavia stellata																X		X	
Horned grebe	Podiceps auritus					X	X										X		X	
Pied-billed grebe	Podilymbus podiceps					X	X										X	X	X	X
Double-crested cormorant	Phalacrocorax pelagicus	X	X			X	X									X	X		X	
[illegible]	[illegible]	X	X			X	X				X	X	X	X	X	X	X	X	X	X
Little blue heron	Florida caerulea					X	X												X	X
[illegible] heron	Hydranassa tricolor					X													X	X
Cattle egret	Bubulcus ibis					X											X		X	
Snowy egret	Casmerodius albus					X	X										X	X	X	X
[illegible] egret	Leucophoyx thul[illegible]					X	X												X	
Black-crowned night heron	Nycticorax nycticorax					X	X	X			X	X	X	X	X	X	X			X
Yellow-crowned night heron (+)	Nyctanassa violacea					X													X	
Green heron	Butorides virescens	X	X			X	X	X									X	X	X	X
[illegible] bittern (+)	Ixobrychus exilis	X	X				X									X	X		X	
American bittern	Botaurus lentiginosus						X										X	X	X	
Glossy ibis	Plegadis falcinellus					X	X										X		X	
White swan	Cygnus olor																	X	X	
Whistling swan	Olor columbianus					X											X	X	X	
Canada goose	Branta canadensis	X	X			X	X	X	X	X	X			X	X		X	X	X	
[illegible]	Branta [illegible]																			
[illegible] goose	Chen hyperborea																	X	X	
Pintail	Anas acuta					X	X				X	X	X	X	X	X	X			
Blue-winged teal	Anas discors					X	X				X	X	X	X	X	X	X		X	
[illegible]-winged [illegible]	Anas [illegible]					X	X				X	X	X	X	X		X		X	

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Red-necked grebe	Podiceps grisegena																		X	
Mallard	Anas platyrhynchos	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black duck	Anas rubripes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gadwall	Anas strepera																X		X	X
American wigeon	Mareca americana																X		X	
European wigeon	Mareca penelope																		X	
Shoveler	Spatul clypeata																X		X	
Wood duck	Aix sponsa	X	X		X	X	X						X	X	X	X	X	X	X	X
Redhead	Aythya americana								X	X							X		X	X
Ring-necked duck	Aythya collaris										X			X	X		X	X	X	X
Canvasback	Aythya valisineria						X				X			X	X		X		X	X
Lesser scaup	Aythya affinis					X	X				X			X	X		X		X	X
Greater scaup	Aythya marila					X	X				X			X	X				X	
Common goldeneye	Bucephala clangula						X				X			X	X		X	X	X	X
Bufflehead	Bucephala albeola						X				X			X	X		X		X	X
Oldsquaw	Clangula hyemalis										X			X	X		X		X	
White-winged scoter	Melanitta deglandi																		X	
Ruddy duck	Oxyura jamaicensis						X				X	X	X	X	X	X	X			
Hooded merganser	Lophodytes cucullatus					X					X			X	X		X	X	X	X
Common merganser	Mergus merganser					X	X				X			X	X		X	X	X	
Red-breasted merganser	Mergus serrator					X	X							X	X				X	X
Turkey vulture	Cathartes aura	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
Cooper's hawk**	Accipiter cooperii	X				X	X										X	X	X	X
Goshawk	Accipiter genitilis					X											X		X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Sharp-shinned hawk (+)	Accipiter striatus					X											X	X	X	X
Red-tailed hawk	Buteo jamaicensis	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
Black vulture	Coragyps atratus																			
Rough-legged hawk	Buteo lagopus					X											X		X	X
Red-shouldered hawk (+)	Buteo lineatus					X	X				X	X	X	X	X	X	X	X	X	X
Broad-winged hawk	Buteo platypterus	X				X											X		X	X
Golden eagle	Aquila chrysaetos					X												X		X
Bald eagle*, **	Haliaeetus leucocephalus	X				X											X			X
Marsh Hawk (+)	Circus cyaneus	X				X	X				X	X	X	X	X	X	X		X	X
Osprey**	Pandion haliaetus	X				X	X										X	X	X	X
Merlin (Pigeon Hawk) (+)	Falco columbarius					X											X		X	X
Peregrine falcon*, **	Falco peregrinus																		X	X
American kestrel	Falco sparverius	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ruffed grouse	Bonasa umbellus			X	X	X	X				X		X	X	X	X	X	X	X	X
Bobwhite	Colinus virginianus					X	X				X			X	X		X	X	X	X
Ring-necked pheasant (i)	Phasianus colchicus	X	X			X	X				X	X	X	X	X	X	X	X	X	
King rail (+)	Rallus elegans	X	X			X					X			X	X	X	X	X	X	X
Virginia rail	Rallus limicola	X				X	X										X	X	X	X
Clapper rail	Rallus longirostris	X				X														X
Yellow rail	Coturnicops noveboracensis	X																		X
Black rail (+)	Laterallus jamaicensis	X													X		X			X
Sora	Porzana carolina	X											X	X	X	X	X		X	X
Common gallinule	Gallinula chloropus	X				X	X						X	X	X	X	X		X	
American coot	Fulica americana	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Semipalmated plover	Charadrius semipalmatus	X															X		X	
Killdeer	Charadrius vociferus	X	X			X					X	X	X	X	X	X	X	X	X	X
American golden plover	Pluvialis dominica	X															X		X	X
Black-bellied plover	Squatarola squatarola	X															X		X	X
Upland sandpiper	Bartramia longicauda	X	X			X													X	
Piping plover (+)	Charardrius melodus	X	X																	X
Wilson's plover	Charardrius wilsonia																			
Ruddy turnstone	Arenaria interpres	X															X		X	X
American woodcock	Philohela minor	X				X	X				X	X	X	X	X	X	X	X	X	X
Common snipe	Capella gallinago	X				X	X				X	X	X	X	X	X	X	X	X	X
Willet	Catoptrophorus semipalmatus																			X
Whimbrel	Numenius phaeopus	X															X			X
Spotted sandpiper	Actitus macularia	X				X	X									X	X	X	X	X
Dunlin	Erolia alpina	X															X		X	X
Baird's sandpiper	Erolia bairdii																			
White-rumped sandpiper	Erolia fuscicollis	X															X		X	
Purple sandpiper	Erolia maritima	X															X		X	
Pectoral sandpiper	Erolia melanotos	X															X		X	
Least sandpiper	Erolia minutilla	X															X		X	X
Western sandpiper	Ereunetes mauri	X															X		X	
Semipalmated sandpiper	Ereunetes pusillus	X															X		X	X
Stilt sandpiper	Micropalma himantopus	X															X		X	
Solitary sandpiper	Tringa solitaria	X					X										X	X	X	X
Buff-breasted sandpiper	Tryngites subruficollis																X			

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avain		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Short-billed dowitcher	Limnodromus griseus	X															X		X	
Long-billed dowitcher	Limnodromus scolopaceus																			X
Lesser yellowlegs	Totanus flavipes	X					X										X		X	
Greater yellowlegs	Totanus melanoleucus	X					X										X		X	X
Knot	Calidrus cantus	X	X														X			X
Ruff	Philomachus pugnax	X	X								X			X	X		X		X	X
Sanderling	Crocethia alba	X	X								X						X		X	
Northern phalarope	Lobipes lobatus																		X	
Red phalarope	Phalaropus fulicarius	X	X								X						X		X	
Wilson's phalarope	Stegnopus tricolor																			X
Marbled godwit	Limosa haemantica																			X
American oystercatcher	Haematopus palliatus																		X	X
Herring gull	Larus argentatus	X	X				X				X			X	X		X		X	X
Laughing gull	Larus articilla	X	X								X			X	X		X	X	X	X
Ring-billed gull	Larus delawarensis	X	X				X				X			X	X		X		X	X
Great black-backed gull	Larus marinus	X	X				X				X			X	X		X		X	X
Bonaparte's gull	Larus philadelphia																			
Glaucous gull	Larus hyperboreus	X																	X	
Iceland gull	Larus glaucoides																		X	
Black tern	Chlidonias niger																			
Gull-billed tern	Gelochelidon nilotica																			
Caspian tern	Hydroprogne caspia										X								X	
Least tern	Sterna albifrons																			X
Forster's tern	Sterna forsteri	X									X			X			X			X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Common tern	Sterna hirundo	X					X				X			X	X		X		X	X
Royal tern	Thalasseus maximus																			
Black skimmer**	Rhynchops nigra	X									X								X	X
Rock dove (i)	Columba livia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Mourning dove	Zenaidura macroura	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-billed cuckoo	Coccyzus americanus	X	X			X	X				X			X	X	X	X	X	X	X
Black-billed cuckoo	Coccyzus erythropthalmus	X	X			X	X				X			X	X	X	X		X	X
Barn owl	Aegolius acadicus					X					X						X	X	X	X
Short-eared owl (+)	Asio flammeus																		X	X
Long-eared owl	Asio otus					X	X				X			X	X		X		X	
Great horned owl	Bubo virginianus	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X
Screech owl	Otus asio	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Barred owl (+)	Strix varia	X	X			X										X	X	X	X	
Barn owl	Tyto alba	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Whip-poor-will	Caprimulgus carolinensis																			
Common nighthawk	Caprimulgus vociferus					X	X										X	X	X	X
Chimney swift	Chordeiles minor	X	X			X	X									X	X	X	X	X
Ruby-throated hummingbird	Chaetura pelagica	X	X			X	X									X	X	X	X	X
Belted kingfisher	Archilochus colubris					X	X										X	X	X	X
Common flicker	Megaceryle alcyon	X	X			X	X									X	X	X	X	X
Red-bellied woodpecker	Colaptes auratus	X	X			X	X				X	X	X	X	X	X	X	X	X	X
Downy woodpecker	Centurus carolinus					X											X	X	X	X
Hairy woodpecker	Dendrocopos pubescens	X	X			X	X				X	X	X	X	X	X	X	X	X	X
	Dendrocopos villosus					X	X				X	X	X	X	X	X	X	X	X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Red-headed woodpecker (+)	Melanerpes erythrocephalus						X										X	X	X	X
Yellow-bellied sapsucker	Sphyrapicus varius					X	X										X	X	X	X
Pileated woodpecker	Dryocopus pileatus																			
Eastern kingbird	Tyrannus tyrannus	X	X			X	X									X	X	X	X	X
Great crested flycatcher	Myiarchus crinitus	X	X			X	X									X	X	X	X	X
Eastern phoebe	Sayornis phoebe					X	X										X	X	X	X
Yellow-bellied flycatcher	Empidonax flaviventris					X	X												X	X
Least flycatcher	Empidonax minimus					X	X												X	X
Willow flycatcher	Empidonax traillii	X	X			X										X	X			
Olive-sided flycatcher	Nuttallornis borealis																		X	
Acadian flycatcher	Empidonax virescens	X	X			X	X									X				X
Eastern wood pewee	Contopus virens	X	X			X	X									X	X	X	X	X
Horned lark	Eremophila alpestris					X	X										X	X	X	X
Barn swallow	Hirundo rustica	X	X			X	X									X	X	X	X	X
Tree swallow	Iridoprocne bicolor	X	X			X	X									X	X	X	X	X
Cliff swallow	Petrochelidon pyrrhonota																X	X	X	
Purple martin	Progne subis	X	X			X	X									X	X	X	X	X
Bank swallow	Riparia riparia					X	X										X	X	X	
Rough-winged swallow	Stelgidopteryx ruficollis	X	X													X	X	X	X	X
Blue jay	Cyanocitta cristata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common crow	Corvus brachyrhynchos	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fish crow	Corvus ossifragus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-capped chickadee	Parus atricapillus					X											X	X	X	X
Carolina chickadee	Parus carolinensis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

APPENDIX C

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FAUNAL SPECIES		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Cedar waxwing	Bombycilla cedrorum	X	X			X	X				X			X	X	X	X	X	X	X
Loggerhead shrike	Lanius ludovicianus																X		X	X
Northern shrike	Lanius excubitor																		X	
Starling (i)	Sturnus vulgaris	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Yellow-throated vireo	Vireo flavifrons					X					X			X	X		X		X	X
Warbling vireo	Vireo gilvus						X											X	X	
White-eyed vireo	Vireo griseus	X	X			X	X				X			X	X	X	X	X	X	X
Red-eyed vireo	Vireo olivaceus	X	X			X	X				X			X	X	X	X		X	X
Philadelphia vireo	Vireo philadelphicus																		X	X
Solitary vireo	Vireo solitarius					X											X		X	X
Black-throated blue warbler	Dendroica caerulescens					X	X											X	X	X
Bay-breasted warbler	Dendroica castanea					X	X										X		X	X
Cerulean warbler	Dendroica cerulea					X													X	
Yellow-rumped warbler	Dendroica coronata					X	X										X	X	X	X
Prairie warbler	Dendroica discolor					X	X				X			X	X		X	X	X	X
Yellow-throated warbler	Dendroica dominica																		X	
Blackburnian warbler	Dendroica fusca					X	X				X			X	X		X		X	X
Magnolia warbler	Dendroica magnolia					X	X				X			X	X		X		X	X
Palm warbler	Dendroica palmarum					X	X				X			X	X		X	X	X	X
Chestnut-sided warbler	Dendroica pensylvanica					X	X				X			X	X		X		X	X
Yellow warbler	Dendroica petechia	X	X			X	X				X			X	X	X	X			X
Pine warbler	Dendroica pinus					X	X											X	X	X
Blackpoll warbler	Dendroica striata	X	X			X	X				X			X	X	X	X		X	X
Cape May warbler	Dendroica tigrina					X	X										X		X	X

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FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Black-throated green warbler	Dendroica virens					X	X										X		X	X
Common yellowthroat	Geothlypis trichas	X	X			X	X				X			X	X	X	X	X	X	X
Worm-eating warbler	Helmintheros vermivorous					X	X												X	
Yellow-breasted chat	Icteria virens					X	X										X	X	X	X
Swainson's warbler	Limnothlypis swainsonii																			
Black and white warbler	Mniotilta varia					X	X				X			X	X		X	X	X	X
Connecticut warbler	Oporornis agilis					X					X			X	X		X		X	X
Kentucky warbler	Oporornis formosus										X			X	X		X		X	X
Mourning warbler	Oporornis philadelphia					X													X	X
Northern parula warbler	Parula americana	X	X			X	X				X			X	X	X	X		X	X
Prothonotary warbler	Protonotaria citrea	X	X								X			X	X	X		X	X	X
Ovenbird	Seiurus aurocapillus					X					X			X	X		X	X	X	X
Louisiana waterthrush	Seiurus motacilla																X	X	X	X
Northern waterthrush	Seiurus noveboracensis					X	X				X			X			X		X	X
Orange-crowned warbler	Vermivora celata					X					X			X	X		X	X	X	X
Golden-winged warbler	Vermivora chrysoptera					X					X			X	X		X	X	X	X
Tennessee warbler	Vermivora peregrina					X	X				X			X	X		X		X	X
Blue-winged warbler	Vermivora pinus	X	X			X	X				X			X	X		X	X	X	X
Nashville warbler	Vermivora ruficapilla					X	X				X			X	X		X		X	X
Canada warbler	Wilsonia canadensis					X					X			X	X		X		X	X
Hooded warbler	Wilsonia citrina					X					X			X	X		X		X	X
Wilson's warbler	Wilsonia pusilla					X					X			X	X				X	X
American redstart	Setophaga ruticilla					X	X				X			X	X		X	X	X	X
House sparrow (i)	Passer domesticus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

APPENDIX C

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FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tufted titmouse	Parus bicolor	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-breasted nuthatch	Sitta carolinensis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-breasted nuthatch	Sitta canadensis		X	X	X	X	X				X				X		X	X	X	X
Brown creeper	Certhia familiaris					X											X	X	X	X
House wren	Troglodytes aedon	X	X			X										X	X	X	X	X
Winter wren	Troglodytes troglodytes																X	X	X	X
Carolina wren	Thryothorus ludovicianus	X	X			X										X	X	X	X	X
Long-billed marsh wren	Telmatodytes palustris	X	X													X	X		X	X
Short-billed marsh wren (+)	Cistothorus platensis																		X	X
Mockingbird	Mimus Polyglottos	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Gray catbird	Dumetella carolinensis	X	X			X										X	X	X	X	X
Bohemian waxwing	Bombycilla garrulus																			
Brown thrasher	Toxostoma rufum	X	X		X	X					X			X	X		X	X	X	X
American robin	Turdus migratorius	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wood thrush	Hylocichla mustelina	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hermit thrush	Hylocichla guttata					X					X			X			X		X	X
Swainson's thrush	Hylocichla ustulata	X	X			X					X					X	X		X	X
Gray-cheeked thrush	Hylocichla minima					X											X		X	X
Veery	Hylocichla fuscescens	X	X			X	X			X	X			X	X	X	X	X	X	X
Eastern bluebird	Sialia sialis					X		X	X		X			X	X		X	X	X	X
Blue-gray gnatcatcher	Polioptila caerula	X	X			X					X			X	X	X	X	X	X	X
Golden-crowned kinglet	Regulus satrapa					X					X			X	X		X	X	X	X
Ruby-crowned kinglet	Regulus calendula					X					X			X	X		X	X	X	X
Water pipit	Anthus spinoletta																X		X	

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FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Bobolink (+)	Dolichonyx oryzivorus					X	X				X			X	X		X	X	X	
Eastern meadowlark	Sturnella magna		X	X	X	X	X				X						X	X	X	X
Red-winged blackbird	Agelaius phoeniceus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rusty blackbird	Euphagus carolinus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Northern oriole	Icterus galbula	X	X			X	X				X						X	X	X	X
[illegible]	Icterus spurius																X	X	X	
Boat-tailed grackle	Cassidix mexicanus																X			
[illegible]	Quiscalus quiscula	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brown-headed cowbird	Molothrus ater	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Scarlet tanager	Piranga olivacea					X	X				X			X	X		X	X	X	X
Summer tanager	Piranga rubra										X			X	X		X		X	
Cardinal	Richmondena cardinalis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Blue grosbeak	Guiraca caerulea																X		X	
Evening grosbeak	Hesperiphona vespertina					X	X				X			X	X		X	X	X	X
Rose-breasted grosbeak	Pheucticus ludovicianus	X	X			X	X										X	X	X	X
Pine grosbeak	Pinicola enucleator																			
Indigo bunting	Passerina cyanea	X	X			X	X										X	X	X	X
House finch	Carpodacus mexicanus						X										X		X	
Purple finch	Carpodacus purpureus																X	X	X	X
Common redpoll	Acanthis flammea					X	X												X	X
Pine siskin	Spinus pinus					X	X										X	X	X	X
American goldfinch	Carduelis tristis	X	X			X	X				X			X	X		X	X	X	X
Red crossbill	Loxia curvirostra					X					X			X	X		X	X	X	X
White-winged crossbill	Loxia leucoptera					X					X			X	X		X		X	X

APPENDIX

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Avian		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Dickcissel	Spiza americana					X					X			X	X				X	
Rufous-sided towhee	Pipilo erythrophthalmus	X	X			X	X				X			X	X	X	X	X	X	X
Grasshopper sparrow (+)	Ammodramus savannarum	X				X					X			X	X		X		X	
Sharp-tailed sparrow	Ammospiza caudacuta																			X
Seaside sparrow	Ammospiza maritima																	X	X	X
Lapland longspur	Calcarius lapponicus																		X	
Lark sparrow	Chondestes grammacus																		X	
Dark-eyed junco	Junco hyemalis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Swamp sparrow	Melospiza georgiana	X	X			X	X				X			X	X	X	X	X	X	X
Lincoln's sparrow	Melospiza lincolnii																		X	X
Song sparrow	Melospiza melodia	X	X			X	X				X			X	X	X	X	X	X	X
Ipswich sparrow (+)	Passerculus princeps																			
Savannah sparrow	Passerculus sandwichensis						X				X			X	X		X	X	X	X
Fox sparrow	Passerella iliaca					X	X				X			X	X		X	X	X	X
Henslow's sparrow (+)	Passerherbulus henslowii																		X	X
Snow bunting	Plectrophenax nivalis										X			X	X		X		X	
Vesper sparrow (+)	Pooecetes gramineus					X					X			X	X		X	X	X	X
Tree sparrow	Spizella arborea					X	X				X	X	X	X	X	X	X	X	X	X
Chipping sparrow	Spizella passerina					X	X				X	X	X	X	X	X	X	X	X	X
Field sparrow	Spizella pusilla					X	X				X	X	X	X	X	X	X	X	X	X
White-throated sparrow	Zonotrichia albicollis	X				X	X				X	X	X	X	X	X	X	X	X	X
White-crowned sparrow	Zonotrichia leucophrys	X				X	X				X	X	X	X	X	X	X	X	X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Mammals		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Opossum	Didelphis marsupialis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Masked shrew	Sorex cinereus																			X
Long-tailed shrew	Sorex dispar																			
Smoky shrew	Sorex fumeus																			X
Short-tailed shrew	Blarina brevicauda	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
[illegible]	Cryptotis parva	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hairy-tailed mole	Parascalops breweri																			X
[illegible] mole	Scalops aquaticus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Star-nosed mole	Condylura cristata					X	X				X	X	X	X	X	X	X		X	X
Little brown myotis	Myotis lucifugus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Keen's myotis (t) = (+)	Myotis keenii																			X
Small-footed myotis (t)	Myotis leibii																			
Eastern pipistrelle	Pipistrellus subflavus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Big brown bat	Eptesicus fuscus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Silver-haired bat	Lasionycteris noctivagans	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Red bat	Lasiurus borealis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Hoary bat	Lasiurus cinereus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Eastern cottontail	Sylvilagus floridanus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern chipmunk	Tamias striatus					X					X	X	X	X	X	X	X	X	X	X
Woodchuck	Marmota monax					X													X	X
Gray squirrel	Sciurus carolinensis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red squirrel	Tamiasciurus hudsonicus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Southern flying squirrel	Glaucomys volans						X				X	X	X	X	X		X	X	X	X
Beaver	Castor canadensis						X											X	X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Mammals		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Marsh rice rat	Oryzomys palustris	X									X						X			X
Deer mouse	Peromyscus maniculatus																			X
White-footed mouse	Peromyscus leucopus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern woodrat	Neotoma floridona																			
Gapper's red-backed mouse	Clethrionomys gapperi																		X	X
Meadow vole	Microtus pennsylvanicus	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Pine vole	Pitymys pinetorum																X			
Red-backed vole	Clethrionomys gapperi																X			
Woodland vole	Microtus pinetorum																		X	X
Muskrat	Ondatra zibethicus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Southern bog lemming (+)	Synaptomys cooperi																		X	X
Norway rat (i)	Rattus norvegicus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black rat (i)	Rattus rattus																			X
House mouse (i)	Mus musculus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Meadow jumping mouse	Zapus hudsonius	X				X					X			X	X	X	X		X	X
Woodland jumping mouse	Napeozapus insignis					X					X			X	X					X
Porcupine	Erethizon dorsatum																			
Red fox	Vulpes vulpes	X				X		X			X			X	X	X	X	X	X	X
Gray fox	Urocyon cinereoargenteus	X				X					X			X	X	X	X	X	X	X
Raccoon	Procyon lotor	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Long-tailed weasel	Mustela frenata	X				X					X			X	X		X	X	X	X
Mink	Mustela vison	X				X					X			X	X		X	X	X	X
Striped skunk	Mephitis mephitis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
River otter	Lutra canadensis					X												X	X	X
White-tailed deer	Odocoileus virginianus	X	X	X	X	X	X						X	X	X	X	X	X	X	X

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Amphibians and Reptiles		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northern copperhead	Agkistrodon contortrix					X														
Timber rattlesnake (+)	Crotalus horridus					X													X	X
Eastern worm snake	Carphophis amoenus					X					X			X	X		X	X	X	X
Scarlet snake	Cemophora coccinea																		X	X
Northern black racer	Coluber constrictor	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ringneck snake	Diadophis punctatus					X					X			X	X		X	X	X	X
Corn snake	Elaphe guttata					X					X	X	X	X	X			X	X	X
Black rat snake	Elaphe obsoleta					X					X	X	X	X	X	X	X	X	X	X
Eastern hognose snake	*Heterodon platyrhinos*					X					X	X	X	X	X		X	X	X	X
Eastern kingsnake	Lampropeltis getulus					X					X	X	X	X	X		X	X	X	X
Eastern milksnake	Lampropeltis triangulum triangulum					X					X	X	X	X	X		X	X	X	X
Coastal plans milksnake	Lampropeltis triangulum x elapsoides					X														
Northern water snake	Natrix sipedon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rough green snake	Opheodrys aestivus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern pine snake	Pituophis melanoleucus					X					X			X	X		X	X	X	X
Northern brown snake	Storeria dekayi										X			X	X		X		X	X
Northern red-bellied snake	Storeria occipitomaculata																		X	X
Ribbon snake	Thamnophis sauritus	X				X					X			X	X		X		X	X
Garter snake	Thamnophis sirtalis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern earth snake (+)	Virginia valeriae					X					X			X	X				X	
Spotted salamander	Ambystoma maculatum					X											X		X	
Marbled salamander	Ambystoma opacum					X											X		X	
Eastern tiger salamander**	Ambystoma tigrinum		X			X	X						X					X	X	

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Amphibians and Reptiles		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northern dusky salamander	Desmognathus fuscus					X	X				X	X	X	X	X				X	X
Northern two-lines salamander	Eurycea bislineata					X	X				X	X	X	X	X				X	X
Four toed salamander	Hemidactyleum scutatum						X				X	X	X	X	X		X		X	X
Red spotted newt	Notophthalmus viridescens	X				X	X				X	X	X	X	X		X	X	X	X
Redbacked salamander	Plethodon cinereus					X	X				X	X	X	X	X		X		X	X
Slimy salamander	Plethodon glutinosus					X	X				X	X	X	X	X					X
Eastern mud salamander	Pseudotriton montanus						X				X	X	X	X	X				X	X
Northern red salamander	Pseudotriton ruber					X	X				X	X	X	X	X				X	X
Five-lined skink	Eumeces fasciatus					X	X				X	X	X	X	X		X	X	X	X
Ground skink	Leiolopisma laterale					X	X				X	X	X	X	X		X	X	X	X
Northern fence lizard	Sceloporus undulatus					X	X				X	X	X	X	X		X	X	X	X
Snapping turtle	Chelydra serpentina	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern painted turtle	Chrysemys picta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red bellied turtle	Chrysemy rubriventris	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotted turtle	Clemmys guttata	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
Wood turtle	Clemmys insculpta					X					X			X	X				X	X
Bog turtle##	Clemmys muhlenbergi		X			X	X				X	X							X	X
Eastern mud turtle	Kinosternon subrubrum	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Northern diamondback terrapin	Malaclemys terrapin	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stinkpot	Sternotherus odoratus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern box turtle	Terrapene carolina	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X
Eastern spiny softshell	Trionyx spiniferus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—
Yellow-bellied turtle	Chrysemys scripta																			

APPENDIX C

FAUNA REPORTEDLY FOUND WITHIN THE STUDY AREA

FAUNAL SPECIES - Amphibians and Reptiles		DRAINAGE BASIN																		
COMMON NAME	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northern cricket frog	Acris crepitans					X					X			X	X		X		X	X
New Jersey chorus frog	Pseudacris triseriata					X					X	X	X	X	X		X		X	X
Pine Barrens treefrog (+)	Hyla andersoni					X		X			X			X	X			X	X	X
Spring peeper	Hyla crucifer					X	X				X	X	X	X	X		X	X	X	X
Gray treefrog	Hyla versicolor & H. chrysoscelis		X			X					X	X	X	X	X		X	X	X	X
Bullfrog	Rana catesbeiana	X				X	X				X	X	X	X	X		X	X	X	X
Green frog	Rana clamitans	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X
Pickerel frog	Rana palustris	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wood frog	Rana sylvatica					X					X			X	X		X		X	X
Southern leopard frog	Rana utricularia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Carpenter frog	Rana virgatipes					X	X				X			X	X				X	X
Fowler's toad	Bufo woodhousei					X	X				X	X	X	X	X	X	X	X	X	X
Eastern spadefoot	Scaphiopus holbrooki	X	X	X	X	X	X				X	X	X	X	X		X	X	X	X

APPENDIX D

Environmental questionnaires mailed to organizations concerned with the study area.

Sample Form Letter

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Star Route
Absecon, New Jersey 08201

Dear Sir:

The U.S. Fish and Wildlife Service is currently attempting to compile all existing information on fish and wildlife resources in Burlington, Camden and Gloucester Counties. To help accomplish this feat, we are writing to all environmental commissions and groups concerned with this geographic region.

Enclosed is a questionnaire which we would appreciate your completing and returning promptly in the stamped, self-addressed envelope.

If there are any questions or if additional information concerning our investigation is desired, please do not hesitate to contact me at (609) 652-7272.

Sincerely,

Enclosures

APPENDIX D

Sample Questionnaire

QUESTIONNAIRE ON FISH AND WILDLIFE RESOURCES
IN BURLINGTON, CAMDEN and GLOUCESTER COUNTIES

Name of Person Completing this Form:_____

Phone No.:_____ Date:_____

Name of Environmental Commission/Group:_____

_____

Address:_____

Phone No.:_____

Does your organization possess and/or is willing to loan any of the following sources (Reference by author, title, date and area):

Natural Resource Inventories:_____

_____

Water Quality Data:_____

_____

Vegetative Cover Maps:_____

_____

Other Maps (e.g., floodplain):_____

_____

Recreational Use Data:_____

_____

Reports on Fish and Wildlife Resources:_____

_____

Other Information:_____

_____

List people who are knowledgeable of fish and wildlife resources in your geographic area:

NAME	ADDRESS	PHONE NO.

APPENDIX TABLE D-1

Organizations Receiving Questionnaire and Those Responding

Organization	Responding
1. American Institute of Planners	
2. Barrington Borough Environmental Comm.	
3. Burlington County Natural Sciences Club	
4. Bass River Township Environmental Comm.	X
5. Burlington Township Environmental Comm.	
6. Camden County Environmental Agency	X
7. Camden County Parks Eco-Center	
8. Camden City Environmental Comm.	
9. Cherry Hill Township Environmental Comm.	
10. Chesterfield Township Environmental Comm.	X
11. Clementon Borough Environmental Comm.	
12. Collingswood Borough Environmental Comm.	X
13. Conservation and Environmental Studies Cntr.,Inc.	X
14. Deptford Township Environmental Comm.	
15. Edgewater Park Township Environmental Comm.	
16. Environmental Concern Organization	
17. Dr. Richard Forman, Rutgers University	X
18. Franklin Township Environmental Comm.	X
19. Gibbsboro Environmental Comm.	
20. Glassboro Township Environmental Comm.	X
21. Gloucester County Nature Club	
22. Great Egg Harbor River Association	
23. Greenwich Township Environmental Comm.	
24. Haddon Heights Environmental Comm.	
25. Haddonfield Borough Environmental Comm.	
26. Harrison Township Environmental Comm.	
27. Hi-nella Borough Environmental Comm.	
28. Lindenwold Borough Environmental Comm.	
29. Magnolia Borough Environmental Comm.	

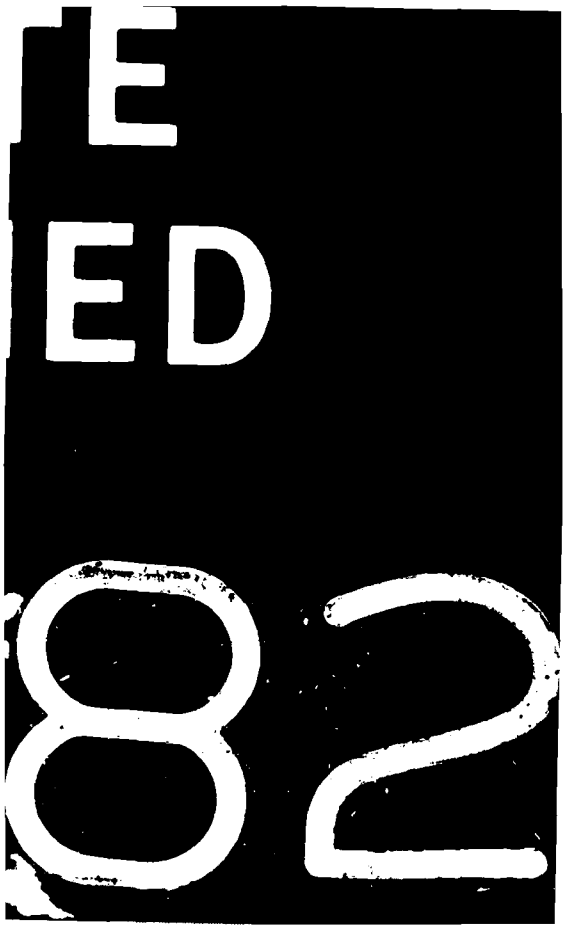
Appendix Table D-1

Organization	Responding
30. Mantua Township Environmental Comm.	
31. Medford Township Environmental Comm.	
32. Monroe Township Environmental Comm.	
33. Mount Ephraim Borough Environmental Comm.	
34. Mount Laurel Township Environmental Comm.	
35. National Association of Conservation Districts	
36. New Jersey Association of Natural Resource Districts	
37. New Jersey Bass Chapter Federation	
38. New Jersey Commission on Open Space Policy	
39. New Jersey Conservation Foundation	
40. New Jersey Public Interest Research Group	
41. New Jersey State Federation of Sportsmen's Clubs	
42. New York/New Jersey Trail Conference, Inc.	
43. Oaklyn Borough Environmental Comm.	
44. Paulsboro Borough Environmental Comm.	
45. Pemberton Township Environmental Comm.	
46. Pennsauken Township Environmental Comm.	
47. Pine Barrens Conservationists	
48. Pompeston Creek Watershed Association, Inc.	X
49. Rancocas Watershed Association	
50. Riverside Township Environmental Comm.	
51. Sierra Club - New Jersey Chapter	
52. Somerdale Borough Environmental Comm.	
53. Southhampton Township Environmental Comm.	
54. South Jersey Resource Conservation and Dev. Council	X
55. STEM (Save the Environment of Moorestown)	
56. Stratford Township Environmental Comm.	X
57. Swedesboro Borough Environmental Comm.	
58. Voorhees Township Environmental Comm.	
59. Wenonah Borough Environmental Comm.	X

Appendix Table D-1

Organization	Responding
60. West Deptford Township Environmental Comm.	
61. The Wildlife Society, New Jersey Chapter	X
62. Willingboro Township Environmental Comm.	
63. Woodland Township Environmental Comm.	

Total Number Solicitations	Number Responders	Percent Responders
63	13	20.6%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